Object Mass Nouns: A Frame Based Analysis

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To everyone who was ever made to feel like they didn't count.

Abstract

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by Kurt Erbach

The hypothesis explored in this thesis is that the number of object mass nouns (e.g. *furniture, jewelry*) in a given language is related to the number of morphosyntactic environments sensitive to the countability nouns (e.g. *many, much*) in that language. This hypothesis, together with the analysis of Sutton and Filip (2016b,c, 2018, 2019); Filip and Sutton (2017) best captures the occurrence of object mass nouns across languages. The analysis of Sutton and Filip (2016b,c, 2018, 2019); Filip and Sutton (2017) accurately predicts which class of nouns will have object mass nouns across languages—collective artifacts—and my hypothesis provides a means of predicting the amount of object mass nouns in a given language: languages with many morphosyntactic reflexes of the mass/count distinction will likewise have many object mass nouns—e.g. English—and languages with few morphosyntactic reflexes of the mass/count distinction will likewise have few object mass nouns—e.g. Greek, Hungarian, and Japanese.

I show that certain theories of the mass/count distinction, namely those of Chierchia (2010, 2015) and Rothstein (2010, 2017) are respectively too strong and too weak in terms of their ability to account for the presence of small classes of object mass nouns in Greek, Hungarian, and Japanese. I extend the analysis of Sutton and Filip (2016b,c, 2018, 2019); Filip and Sutton (2017) to account for the characteristic properties of the mass/count distinctions in Greek, Hungarian, and Japanese, and I show that this analysis of countability, together with my hypothesis about the relationship between morphosyntactic reflexes and object mass nouns, accurately predicts the conceptual class and amount of object mass nouns in each of these languages. What follows from my hypothesis is the idea that there are several factors at play in determining the amount of object mass nouns in a given language, rather than just one as argued by Chierchia (2010, 2015). Such characteristics include the use of morphosyntax including but not limited to number marking, classifiers, mass/count specific determiners, derivational morphology such as *-wear/ware* in English; the frequency of use of each of such morphosyntax; and the size of the relevant lexicon—i.e. the amount of such morphosyntax and the number of nouns in a given language.

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Abbreviations

1	first person
3	third person
ACC	accusative
ASP	aspect
CARD	cardinality
CL	classifier
COCA	Corpus of Contemporary American English
DAT	dative
DE	modification
GEN	genitive
INDEF	indefinite
INF	infinitive
LOC	locative
N	noun
NEUT	neuter
NOM	nominative
NPI	negative polarity item
OED	Oxford English Dictionary
PERF	perfective
PL	plural
POSS	possessive
PRES	present
PROG	progressive
PST	past
QUD	question under discussion

REL	relative
SG	singular
SUBJ	subject
STUB	stubbornly distributive predicate
TOP	topic
TRANS	translative

Note: any glosses/abbreviations not listed here could not be determined based on the source material from which they came.

Chapter 1

Introduction

> What makes fake mass nouns interesting is that they constitute a fairly recurrent type of non canonical mass nouns, and yet they are subject to micro-variation among closely related languages. For all we know, the phenomenon of fake mass appears to be restricted to number marking languages. It is unclear that classifier languages like Mandarin and number neutral languages like Dëne display a class of cognitively count nouns with the morphosyntax of mass nouns. In view of this intricate behavior, fake mass nouns arguably constitute a good testing ground for theories of the mass/count distinction. (Chierchia 2010, p. 111)

This thesis takes Chierchia's observation about 'fake mass' nouns, also known as 'object mass' nouns, as a point of departure into research on mass/count phenomena across typologically distinct languages. The guiding question is as follows: To what extent do object mass nouns constitute a good testing ground for theories of the mass/count distinction? The main data will be drawn from several typologically distinct languages, Greek (Indo-European), Hungarian (Uralic), and Japanese (Japonic). I will explore recent research on how the mass/count distinction is realized in these languages, if at all, since classifier languages like Japanese are often assumed to have no grammaticized lexical mass/count distinction among nouns. Furthermore, object mass nouns will be at the center of this exploration. This in turn will allow for an investigation into the predictive/explanatory power of mereological theories of the mass/count distinction, which in the past twenty years or so have formulated the most precise and influential proposals regarding the mass/count distinction in natural languages. Furthermore, this research will provide support for the hypothesis that there is a correlation between the number of object mass nouns and the number of morphosyntactic environments sensitive to the mass/count properties of nouns in a language.

Object mass nouns have played a central role in mereological theories of the mass/count distinction, because these nouns pose formidable challenges for specifying what it means for a noun to be grammatically mass or count (Chierchia 1998a, 2010; Rothstein 2010; Landman 2011, 2016; Sutton and Filip 2016b). While prototypical count nouns like *chair* and *spoon* can combine directly with numericals and count determiners like *each, every* and *many*, mass nouns like *furniture* and *silverware* cannot, despite the fact that both classes of nouns denote discrete objects. In this respect, object mass nouns pattern just like prototypical mass nouns like *mud* and *sweat*, which denote undifferentiated stuff rather than discrete objects. It is precisely this disconnect between perceptual properties (denotation) and grammatical properties exhibited by object mass nouns that makes their existence in a given language one of the best arguments in support of showing that the language has a grammaticized lexical mass/count distinction (Chierchia 1998a, 2010; Rothstein 2010; Landman 2011, 2016; Sutton and Filip 2016b; Filip and Sutton 2017).

The mass/count distinction is manifested in the grammar of a given language by a cluster of characteristic properties, which crucially includes the distribution of number marking and determiners across different classes of nouns (cf. Chierchia 2010, (25c)). Chierchia (2010), for example, analyzes these grammatical patterns as the result of nominal semantics with a domain structured as an atomic mereology. Under this analysis, count nouns denote stable atoms and substance mass nouns denote unstable individuals. *Unstable individuals* are atoms relative to some precisifications and sums relative to other precisifications. Obligatory number marking in languages, like Englihs, with a mass/count distinction requires singular and plural nouns to be stably atomic, and because mass nouns denote unstable individuals, they are encoded as denoting a singleton property which cannot be pluralized. That is, mass nouns denote the maximal entity of the sum of unstable individuals. Object mass nouns, like count nouns, denote stable atoms, but they happen to be encoded as singleton properties, which is assumed to be possible via lexical choice, and they are mass as a result. While the existence of object mass nouns is strictly tied to number marking for Chierchia (2010), other analyses explain why nouns can be both object denoting and mass on account of the fact that object mass nouns include sets of non-disjoint individuals in the set of entities that count as 'one' (Landman 2011, 2016; Sutton and Filip 2016c), or because they lack "semantic atoms" (are not indexed to counting contexts) (Rothstein 2011).

Cross-linguistically, the presence or absence of object mass nouns in a given language has been treated as a consequence of the way a each language realizes, or fails to realize, a mass/count distinction (Chierchia 2010). For example, Mandarin does not have obligatory number marking, and nouns cannot be directly counted, rather a classifier is generally obligatory in counting constructions (Chierchia 2010, (25a-c)). A common mereological analysis of such languages is that all bare singular nouns are kind denoting (Chierchia

1998a, 2010, 2015; Rothstein 2017; Wiese and Maling 2005), which accounts for the fact that they can be used as arguments, and that classifier languages, like Mandarin and Japanese, have no grammaticized lexical mass/count distinction, though one does appear in the distribution of classifiers (Chierchia 1998a, 2010, 2015; Wiese and Maling 2005).

However, such formal analyses need to be refined in the light of the variation that we see once we extend our empirical scope. In Greek (Indo-European) for example, the ability to morphologically pluralize mass nouns without a shift in interpretation to kinds or portions has been taken to indicate that its number marking does not function as English number marking does, and therefore that Greek cannot have object mass nouns (Tsoulas 2008; Chierchia 2010). However, Alexiadou (2015) has argued that Greek does in fact have object mass nouns, though no semantic account has been given. On an analysis in which object mass nouns specify sets of non-disjoint objects for counting Landman (2011, 2016); Sutton and Filip (2016b), it is possible to account for object mass nouns in Greek despite the fact that Greek also has number marking unlike that in English.

The presence of both a mass/count distinction and classifiers in Hungarian (Uralic) has lead to analyses in which almost all nouns denoting discrete objects have both a count denotation and an object mass denotation, and therefore, behave like dual-life nouns (Rothstein 2017; Schvarcz and Rothstein 2017), while nouns with only an object mass denotation do not seem to occur. I shed doubt on this result by showing that the nouns that Rothstein (2017) and Schvarcz and Rothstein (2017) claim are dual life do not exhibit the behavior one would expect of nouns with a mass denotation. Furthermore, I show that Hungarian has a small number of object mass nouns and dual-life nouns that do exhibit mass behavior in the expected environments. I propose an alternative analysis of Hungarian nouns, namely one in which Hungarian count nouns are semantically number-neutral and classifiers modify numerical expressions rather than modifying mass nouns. This analysis explains why such nouns are felicitous in measure DPs (under an analysis of measure DPs in which they sanction cumulative predicates (Krifka 1989; Filip 1992, 2005; Nakanishi 2003; Schwarzschild 2006, i.a.)), and also explains why they occur bare in counting constructions and with quantifiers. The result of such an analysis is that Hungarian has many count nouns and many mass nouns, contra Rothstein (2017) and Schvarcz and Rothstein (2017) who conclude that Hungarian has many dual-life and mass nouns, but few count nouns.

Sudo (2016, 2015) has shown that Japanese has determiners that exhibit sensitivity to nominal properties in much the same way that determiners are sensitive to the countability of nouns in a language with a grammaticized lexical mass/count distinction. I have built upon this work by showing that certain Japanese nouns exhibit properties of object mass nouns, namely they denote discrete objects and they grammatically pattern

with prototypical mass nouns as opposed to prototypical count nouns. Because analyses in which all nouns in classifier languages are uniformly kind denoting cannot account for such phenomena, I argue for an analysis in which object mass nouns specify sets of non-disjoint objects and are therefore infelicitous with count quantifiers (Landman 2011, 2016; Sutton and Filip 2016b,c, 2018, 2019; Filip and Sutton 2017).

Taken together the empirical properties of Greek, Hungarian, and Japanese, when compared to English, support the hypothesis that the number of object mass nouns correlates with the number of morphosyntactic environments sensitive to the mass/count distinction in a given language. Empirical research shows that Greek, Hungarian, and Japanese are all have few nouns with the characteristic properties of object mass nouns (two-to-six each) and likewise few morphosyntactic environments sensitive to the countability of nouns in that language (two-to-five each). In other words, rather than being a strict bipartite split between languages that can and cannot have object mass nouns, as proposed by Chierchia (2010, 2015) the data in this thesis supports the idea that there is a much more complex and nuanced relationship between the morphosyntax in a language and the mass/count distinction in that language.

This thesis is grounded within a standard mereological theory of nominal semantics in which individuals and sums thereof are of the same semantic type as first suggested by Link (1983). A mereological approach assumes a domain of entities that is structured either by the sum operation, $\sqcup$, or the ordering relation, $\leq$, depending on which is taken to be primitive (Champollion and Krifka 2016). Following Krifka (1989), I assume a complete join-semilattice closed under the sum operation, an idempotent, commutative and associative relation, which is taken as primitive and can be used to define the part operation. Link (1983) first posited separate domains for count nouns and mass nouns: the count domain is atomic, having atoms with no proper parts at the bottom of the join semi-lattice, and the mass domain is non-atomic, being underdetermined. Mereological approaches to nominal semantics since Krifka (1989) typically assume a single domain (cf. Champollion 2017), and some like Krifka (1989) assume it is non-atomic (Grimm 2012; Landman 2016; Sutton and Filip 2016b) while others assume an atomic domain (Chierchia 1998a, 2010, 2015; Rothstein 2010, 2017; Landman 2011). From this theoretical basis, I explore different enrichments that have been made in mereological theories that assume a single domain to account for the combinatorial properties of nouns across languages. The languages explored in this thesis, Greek (Indo-European), Hungarian (Uralic), and Japanese (Japonic), have characteristics that are best accounted for with a mereology based analysis that incorporates a notion of context. Furthermore, the properties of object mass nouns are best accounted for with an approach in which these nouns specify sets of non-disjoint objects, as argued by Landman (2011, 2016); Sutton and Filip (2016b,c, 2018, 2019) and Filip and Sutton (2017).

The contribution of this thesis is threefold: First, this thesis reviews evidence that suggests there is reason to believe that Greek, Hungarian, and Japanese have small, but nevertheless, existing classes of object mass nouns. Second, using these object mass nouns as a testing ground, this thesis shows that the theories of the mass/count distinction argued for by Chierchia (2010, 2015) and Rothstein (2010) cannot be upheld in their current form, though a non-disjointness based analysis such as that of Sutton and Filip (2016b,c, 2018, 2019) and Filip and Sutton (2017) can be upheld with respect to the empirical findings of this thesis. Lastly, this thesis motivates an alternative to Chierchia's (2010) claim that object mass nouns are restricted to languages with number marking like that in English. The alternative hypothesis that is borne out across English, Greek, Hungarian, and Japanese, is that the number of object mass nouns in a language is dependent on the number of morphosyntactic environments sensitive to the mass/count properties of nouns.

1.1 The mass/count distinction in number marking languages

Number marking languages are those that obligatorily mark number on nouns (Chierchia 2015), for example plural morphology in English is obligatory when counting higher than one. The grammaticality of number marking and other morphosyntactic compositions serve to distinguish count nouns from mass nouns and thus uncover the mass/count distinction, since number marking on mass nouns is typically ungrammatical. While some have exhibited favor for term *non-countable* rather than *mass* (e.g. Grimm 2012), I will use the term *mass* because it is that most commonly used (e.g Quine 1960; Pelletier 1975; Link 1983; Bach 1986; Krifka 1989, 1995; Chierchia 1998a, 2010, 2015; Rothstein 2010, 2017; Landman 2011, 2016; Schwarzschild 2011; Doetjes 2012; Sutton and Filip 2016a,b,d, 2017; Deal 2017; Filip and Sutton 2017). That said, the use of the term mass must be clearly delineated so as to not lead to confusion.

As pointed out by Joosten (2003) in his survey of research on the mass/count distinction, the different ways in which terms like *mass* are used by different researchers can lead to confusion, so I will summarize the relevant notions and terminology here. *Objects* and *substances* in the sense of Soja et al. (1991), respectively refer to concrete, solid physical entities like spoons that hold their shape and concrete, non-solid physical entities like mud and water that do not hold their shape:

> solid objects are bodies that are cohesive, bounded, spatiotemporally continuous, and solid or substantial; they move as connected wholes, independently

> of one another, on connected paths though unoccupied space... Non-solid substances are spatiotemporally continuous and substantial, but not cohesive or bounded; they do not retain either their internal connectedness or their external boundaries as they move and contact one another.
>
> (Soja et al. 1991, p. 183)

Count and *mass* refer to both the grammatical classes of nouns and the morphosyntactic environments distinguished used as "tests" for whether or not a noun is count or mass as in Allan (1980) and Chierchia (1998a) among others. For example, count nouns directly combine with numericals (e.g. *three knives*) and are straightforwardly interpreted as referring to a set of objects with a particular cardinality, while mass nouns cannot directly combine with numericals (e.g. *three muds*) unless shifted to an interpretation in which there is a certain cardinality of kinds or portions. Further examples of such tests include quantifiers like *every* and WH-quantifying constructions like *how much*. Nouns like *boulder* are straightforwardly felicitous with *every* but infelicitous with *how much*[1] as in (1.1-a); while nouns like *sand* are infelicitous with *every*[2] but felicitous with *how much* as in (1.1-b). Certain nouns like *stone* are felicitous in both sorts of environments, (1.1-c), and are therefore called *dual-life*.

(1.1) a. every boulder / #how much boulder
b. #every sand / how much sand
c. every stone / how much stone

These patterns of felicity/infelicity give rise to distinct classes of nouns and syntactic environments which are generally referred to as *count* and *mass*. Crucially, the distinction between objects and substances is not identical to the distinction between count nouns and mass nouns, and this misalignment of the two distinctions gives rise to *object mass nouns* like *kitchenware*. Object mass nouns refer to objects but do not grammatically behave like most nouns that refer to objects, which are count, rather they pattern with substance denoting nouns and are therefore mass. As pointed out by Landman (2011), the objects denoted by a noun like *kitchenware* could be counted in multiple ways: a cup and saucer, for example, could be counted as either one piece of kitchenware or as two. In this thesis, I use *individuated entity* to refer to that which is counted—e.g. a cup and saucer are two objects, but can be counted as two individuated entities or one individuated entity—while others (e.g. Link 1983; Chierchia 1998a; Rothstein 2010) have used the term *atom* in one sense for the same purpose.

[1] unless shifted to a substance interpretation
[2] unless shifted to a kind or portion interpretation

Following Huddleston and Pullum (2002); Rothstein (2010) and Erbach et al. (2019), among others, I assume that *dual-life* terms have both count and mass denotations[3]. The mass and count readings of dual-life nouns like *stone* and *hair* are not to be confused with coerced readings of count nouns and mass nouns. Pelletier (1975), inspired by David Lewis, describes a 'universal grinder' by which any object, e.g. a bicycle, can be ground up into a substance and therefore be coerced into having a mass reading, (1.2).

(1.2) After he had finished the job, there was bicycle all over the floor.
(Rothstein 2010, p. 390)

Similarly, Bunt's (1985) 'universal sorter' (or 'universal packager' as it has also been called) has been argued to be able to coerce a countable interpretation of any mass noun, (1.3).

(1.3) They ordered two orange juices, two beers and a single malt scotch.
(Rothstein 2010, p. 391)

While readings like those in (1.2) and (1.3) have sparked much debate about the nature of the mass/count distinction (e.g. Pelletier 1975; Pelletier and Schubert 1989, 2003; Pelletier 2012; Kiss et al. 2016), I follow Rothstein (2010) in assuming that these nouns, unlike dual-life nouns, have a single denotation that can be implicitly operated upon thereby coercing the sort of interpretation necessary in a given context. Despite being used in mass syntax in (1.2), *bicycle* is assumed to only have a count denotation, which has been operated upon by a morphologically null 'grinding' operation in order for (1.2) to be interpreted felicitously. Similarly, despite being used in count morphosyntax in (1.3), *juice* is assumed to have only a mass denotation, which has been operated upon by a morphologically null 'packaging' operation in order for (1.3) to be interpreted felicitously.

While dual-life nouns are compatible with both mass and count interpretations, *number neutral* nouns are those that are compatible with both singular and plural interpretations (Farkas and De Swart 2003; de Swart and Zwarts 2008; Zweig 2009; Espinal 2010; Alexopoulou et al. 2013). Number neutral nouns denote a complete join-semilattice, a mereological structure of individuals and sums thereof. In the case of number neutral nouns, the individuals are countable individuated entities, and these nouns equally felicitously refer to one or more than one individuated entity. In other words, they are not strictly singular, only denoting individuated entities, nor are they exclusive plurals, only denoting sums of individuated entities. An often cited example of number neutrality

[3]The term *flexible* has also been used to label this class of nouns rather than *dual-life* (Rothstein 2010, 2017; Schvarcz and Rothstein 2017, e.g.)

in Hungarian is (1.4), in which the incorporated singular noun *olvas* ('poem') could be interpreted as the singular 'a poem' or plural 'poems'.

(1.4) Mari verset olvas.
Mari poem.ACC read
Mari is reading a poem/poems. (Farkas and De Swart 2003, p. 5)

The difference between a dual-life noun and a number neutral noun is that a dual-life noun regularly occurs with both count and mass morphosyntax, while number neutral nouns as they are generally discussed occur with count morphosyntax and can be interpreted as either singular or plural.

Espinal (2010) points out the ways in which the terms *number neutral* and *general number* have sometimes been conflated and makes a case for distinguishing between the two. Like number neutrality, the term *general number* is sometimes used to describe nouns that are underspecified in respect to number (e.g. Corbett 2000; Rullmann and You 2006; Espinal 2010; Bale et al. 2011; Bale and Khanjian 2014). Rullmann and You (2006), for example, characterize general number in exactly this way, though Corbett (2000) describes general number with respect to nominal expressions without commitment to number. Espinal (2010), on the other hand, distinguishes number neutrality from general number. In her analysis, general number is used to describe lexical roots that express general meaning and have no reference to number, while number neutrality is used to describe nominal expressions that are under-specified for number. In this thesis, I follow Espinal (2010) in using *number neutral* to refer explicitly to nominal expressions that are not marked for number–i.e. that can equally felicitously refer to both individuals and pluralities.

Given number neutral nouns are those that refer to individuated entities and sums thereof, they must be distinguished from inclusive plurals. Inclusive plurals are plural count nouns that refer to individuated entities and sums thereof. What distinguishes number neutral nouns from inclusive plural nouns is that only the latter have any overt number marking, namely plural morphology. Inclusive plurals also stand in opposition to exclusive plurals, which are plural count nouns that exclusively refer to sums of individuated entities. Unmarked (singular) count nouns in English, like that in (1.5-a), are widely assumed to have singular reference, (1.6-a) (Link 1983; Chierchia 1998a, 2010, 2015; Rothstein 2010, 2017; Landman 2011, 2016; Sutton and Filip 2016b, among many others). As stated above unmarked (singular) count nouns in Hungarian, like that in (1.4), have been argued to be number neutral (Farkas and De Swart 2003; Farkas and de Swart 2010; Erbach et al. 2019), therefore referring to individuals and sums thereof as in (1.6-b). Plural count nouns in English have been argued to be exclusive plurals

(Chierchia 1998a; Grimm 2013), based on readings of examples like (1.5-b), which is assumed to only be true if Mary read more than one poem (1.6-c). English plural count nouns have also been argued to be inclusive (Chierchia 2010, 2015; Rothstein 2010, 2017; Landman 2011, 2016; Sutton and Filip 2016b, among others) based on examples like (1.5-c), which can be answered affirmatively if Mary read even only a single poem.

(1.5) a. Mary read a poem.
b. Mary read poems.
c. Did Mary read poems?

(1.6) a. $N_{singular} = \{a, b, c\}$
b. $N_{number.neutral} = \{a, b, c, a⊔b, a⊔c, b⊔c, a⊔b⊔c\}$
c. $N.PL_{exclusive} = \{a⊔b, a⊔c, b⊔c, a⊔b⊔c\}$
d. $N.PL_{inclusive} = \{a, b, c, a⊔b, a⊔c, b⊔c, a⊔b⊔c\}$

The analysis of plural count nouns in English is a domain of research with several debates that are outside the scope of this thesis. One analysis of the readings of plural count nouns will be reviewed in Chapter 6, namely that of Farkas and de Swart (2010), who attempt to account for both number neutrality, inclusive plural readings, and exclusive plural readings in Hungarian. This discussion of number neutrality is crucial to the discussion of analyses of object mass nouns because number neutral count nouns are a count correlate to the uncountable semi-lattices that are assumed to be denoted by mass nouns in many analyses of the mass/count distinction (e.g. Chierchia 1998a; Wiese and Maling 2005; Rothstein 2010, 2017; Deal 2017).

1.1.1 Object mass nouns

Object mass nouns, exemplified by *furniture* and *jewelry* in English, are often characterized according to two key properties: (i) they refer to objects, and (ii) they grammatically pattern with mass nouns. The objects referred to by object mass nouns are seen to be semantically available in *more than* comparisons (Barner and Snedeker 2005) and with sortal "classifiers" like *piece of* (Rothstein 2010, p. 371). The fact that these objects are not always available is made evident by the fact that these nouns do not grammatically pattern with prototypical object referring nouns like *chair, table* and *sofa* in counting constructions, with count determiners, etc. Instead, object mass nouns pattern with canonical mass nouns like *sand* in the majority of morphosyntactic environments; for example, object mass nouns, like other mass nouns, do not occur with count determiners like *each, every,* and *many* though they do occur with mass determiners like *much.* There

are many ways in which object mass nouns can be shown to grammatically pattern with other mass nouns but also be distinguished with respect to the way they refer to objects. So long as a language has a means of distinguishing mass nouns from count nouns, these morphosyntactic environments and a series of semantic tests can be used to test whether or not a language also has object mass nouns.

This thesis shows that, across typologically diverse languages, nouns with the characteristic properties of object mass nouns seem to arise despite the fact that the languages themselves differ in the extent to which they manifest properties of the mass/count distinction. For example, Japanese differs from English in that, among other things, it lacks obligatory number marking, which in part has lead to Chierchia's (2010) claim that languages like Japanese cannot have object mass nouns. However, recent research shows that Japanese has some determiners that are sensitive to the countability of nouns (Sudo 2015), and such determiners have been used as tests to uncover a set of nouns in Japanese with the characteristic properties of object mass nouns (Erbach et al. 2017). This shows that the existence of object mass nouns is more language independent than has been previously assumed (cf. Chierchia 2010, 2015). What we see is that the data in a given language constitutes a choice point that constrains how object mass nouns should be treated theoretically.

As a class, object mass nouns are also more semantically coherent than purely lexical arguments would argue (cf. Barner and Snedeker 2005; Chierchia 2010; Rothstein 2010). Certain approaches allow for any noun that refers to objects to potentially be encoded as an object mass noun, in a language with the prerequisite properties, (Chierchia 1998a, 2010, 2015; Barner and Snedeker 2005; Rothstein 2010, 2017; Landman 2011), and therefore predict that object mass nouns should not be restricted to any particular kind of objects. However, this prediction is not borne out. What we see across languages is that object mass nouns tend to arise among nouns that refer to artifacts (Sutton and Filip 2016b) that occur in close proximity to one another (Barner and Snedeker 2005), and that refer to objects that overlap with respect to what counts as 'one' (Landman 2011)—e.g. *kitchenware* is often sold in sets and certain sums of objects, like a teapot and its lid, might be counted as single items of kitchenware rather than two. At the same time, we see that predicting the behavior and distribution of this class of nouns requires an analysis that is more complex than one that assumes these nouns only denote uncountable semi-lattices (cf. Chierchia 1998a; Rothstein 2010, 2017).

1.1.2 Mereology and the mass/count distinction: Link (1983)

Link (1983) provides the first mereological analysis of the semantic underpinnings of the

mass/count distinction. While this analysis, like several of those that follow, is unable to account for certain data, it nevertheless establishes many of the theoretical assumptions that continue to be made by semanticists who attempt to construct more comprehensive analyses of the mass/count distinction.

Link (1983) sets out to provide an analysis of mass nouns and plural count nouns that captures both the similarities between these two types of nouns and the differences between mass nouns and count nouns. The main intuitions behind these patterns include collective reference of both mass nouns and plural count nouns, and the discussion of cumulative reference in Quine (1960). Collective reference is that over a group of objects and is seen in the presence of predicates like *gather*, which are compatible with mass nouns and plural count nouns.

(1.7) a. The children gather around their teacher.
b. The water gathers in big pools. (Link 1983, p. 127)

The sort of cumulative reference referred to by Quine (1960) is the property of both mass nouns and plural count nouns to apply to distinct entities and their sum. For example, two entities in the extension of *water*, when taken together are still in the extension of *water*, and the same sort of example can be constructed for plural count nouns like *children*.

The innovation that Link (1983) brings to the discussion of nominal phenomenon is the mereological structure of entities in the nominal domain. Link (1983) assumes the domain is structured as a join semilattice (graphically represented in (1.9)), and he splits this domain into two parts, one that contains atoms and sums thereof, which are countable and comprise the denotation of singular and plural count nouns respectively, and one that contains non-atoms and sums thereof, which are not countable and comprise the denotations of mass nouns. A complete join-semilattice is the mathematical structure generated from some entities, e.g. *a, b, c*, and either the sum operation $\sqcup$ or the ordering relation $\leq$. Link (1983) assumes the sum operation $\sqcup$ to be primitive and used to generate sums of entities. The sum operation can be used to define the ordering relation $\leq$, (1.8), and therefore give structure to the nominal domain, E, as in (1.9).

(1.8) $x \leq y$ iff $x \sqcup y = y$ (Link 1983, p. 131)

(1.9)
$$\left.\begin{array}{c} \left.\begin{array}{c} a \sqcup b \sqcup c \\ a \sqcup b,\ a \sqcup c,\ b \sqcup c \end{array}\right\} {}^{\circledast}P \\ \begin{array}{ccc} a & b & c \end{array}\ \}\ P \end{array}\right\} {}^{*}P$$

Link (1983) introduces the * operation as a semantic correlate to morphological pluralization. For a one-place predicate, P, that denotes atoms—e.g. individual playing cards from a deck—the * operation works on one-place predicates by generating all of the possible sums of the members of P—e.g. all possible sums of the individual playing cards. In the same way that the plural count noun *cards* can be defined in terms of the singular count noun *card*, a plural predicate $^*P$ is defined in terms of the singular predicate P. Formally, a plural predicate $^*P$ denotes the complete join-semilattice generated by the closure of P under sum (represented in (1.9) and defined in (1.10) where E is the domain of entities and $\sup_i$) is the supremum operation. The *proper plural predicate*, $^\circledast P$, is only true of the sums in the extension of $^*P$; it is not also true of the entities in the extension of P.

(1.10) $[\![^*P]\!] = \{x \in E \mid \exists X \subseteq [\![P]\!] \wedge X \neq \varnothing \text{ s.t. } x = \sup_i X\}$ (Link 1983, p. 138)

A plural predicate, $^*P$, has cumulative reference: for any entities that are in the denotation of $^*P$, their mereological sum is also $^*P$. Cumulative reference is what distinguishes plural count nouns from singular count nouns, and since mass nouns also have cumulative reference, Link (1983) argues that both mass nouns and plural count nouns denote semi-lattices of entities, though the lattices are non-atomic and atomic respectively. The motivation for the difference in atomicity is being able to use distinct nominal expressions, namely a mass noun and plural count noun, to refer to entities occupying the same space with contradictory modifying predicates as in (1.11).

(1.11) The gold in Smith's ring is old, but Smith's ring is not old.(Link 1983, p. 135)

Linguistic expressions are used to create individuals with the "materialization" function h, therefore making it possible for *rings* and *gold* to refer to the same portion of matter.

Link (1983) uses the proper plural predicate, $^\circledast P$, for bare plurals in existential constructions, (1.12), implying they have strictly exclusive interpretation.

(1.12) a. Children built the raft.
b. $\forall x(^\circledast Px \wedge Qy)$ (Link 1983, p. 134)

One of the primary criticisms of Link (1983) is that splitting count and mass nouns into separate domains does not actually fix the problem it set out to solve. While having a split between atoms and non-atoms that is bridged by the homomorphism, h, can neatly account for the contradictory properties in (1.11), the same is not true of (1.13) (Bach 1986).

(1.13) The snow making up this snowman is quite new but the H_2O making it up is very old (and the H and O even older!).

Bach (1986) shows that Link's homomorphism would require that the snow and H_2O are identical and therefore that the contradictory properties that modify these nouns require an alternative explanation to the split domain. Bach (1986) proposes that we do not analyze constructions like *makes up* and *constitutes* as establishing equivalence between two entities like the snow and H_2O in (1.13). Analyses of the mass/count distinction subsequent to Link (1983) and Bach (1986) typically assume a single mereology for both mass and count nouns (e.g. Krifka (1989); Chierchia (1998a); Rothstein (2010); Landman (2011); Sutton and Filip (2016b)), though there are exceptions (e.g. Champollion 2017).

1.2 Classifier languages

In contrast to number marking languages, classifiers languages are those like Mandarin that require classifiers in counting constructions (Krifka 1995; Chierchia 1998a, 2010, 2015).

(1.14) a. sān qún xíong
three herds bear
'three herds of bears'

b. sān zhī xíong
three CL bear
'three bears' (objects)

c. sān zhǒng xíong
three CL bear
'three bears' (species) (Krifka 1995, pp. 398-399)

As represented in (1.14), certain classifiers differ with respect to what it is they count. For the noun *xíong* ('bear'), the classifier *qún* is used to count groups, *zhī* is used to count individuals (and is therefore called an *individual classifier* or *sortal classifier*), and *zhǒng* is used to count subkinds.

In addition to requiring classifiers in counting constructions, Mandarin does not have obligatory number marking, and Mandarin also lacks definite and indefinite articles (Chierchia 1998a). It is also the case that bare nouns can refer to both kinds and individuals in Mandarin (Krifka 1995).

(1.15) a. xíong júe zhǒng le
bear vanish kind ASP

'the bear is distinct'

b. wǒ kànjiàn xíong le
I see bear ASP
'I saw (some) bears' (Krifka 1995, pp. 398)

It is often the case that these nouns are assumed to refer to kinds rather than individuals (Krifka 1995; Chierchia 1998a, 2010, 2015; Rothstein 2017), which explains why classifiers are needed in counting constructions: they are needed in order to associate the kind with individuals and thereby make counting possible. Krifka (1995) assumes that classifiers like *zhí*, (1.16-a), denote functions that take a numeral denoting numerical, (1.16-b), and then a kind denoting noun, (1.16-c), thereby forming a counting construction (1.16-d)

(1.16) a. $[\![_{N}\text{qún}]\!] = \lambda n \lambda y \lambda i \lambda x[\mathbf{RT}_i(x,y) \wedge \mathbf{OU}_i(y)(x)=n]$
b. $[\![_{N}\text{sān}]\!] = \mathbf{3}$
c. $[\![_{N}\text{xíong}]\!] = \mathbf{Ursus}$
d. $[\![_{N}\text{qún sān xíong}]\!] = \lambda i \lambda x[\mathbf{RT}_i(x,\mathbf{Ursus}) \wedge \mathbf{OU}_i(\mathbf{Ursus})(x)=\mathbf{3}]$

In Krifka's (1995) analysis, classifiers in Mandarin contain the **RT** relation, which is a conflation of the realization relation **R**, a relation that takes a kind and applies to specimens or individual sums thereof in world i, and the taxonomic relation, **T**, a relation that takes a kind applies to subkinds or individual sums thereof in world i. Individual/sortal classifiers in this analysis also contain the additive measure function **OU**, which counts individuals corresponding to a kind.

In addition to Krifka (1995), Bale and Coon (2014) argue that classifiers combine with numericals in their analysis of Chol (Mayan), and Sudo (2016, 2015) and Erbach et al. (2017) propose the same for Japanese. On the other hand, the view in Chierchia (1998a, 2010, 2015) that classifiers combine with nouns is also argued for by Cheng and Sybesma (1998); Nemoto (2005); Wiese and Maling (2005); Li (2011); Rothstein (2017). There is no consensus as to which sort of approach best analyzes counting constructions in classifier languages, though the approach argued for by Chierchia (1998a) in which classifiers combines with nouns is more widespread.

Classifier languages are relevant to discussing the extent to which object mass nouns constitute a testing ground of theories of the mass/count distinction because various claims have been made about the extent to which classifier languages may or may not have object mass nouns. Chierchia (1998a) and Rothstein (2010), for example, treat all object denoting nouns as object mass nouns in classifier languages on the basis that, like object mass nouns in languages that have a mass/count distinction, these nouns require classifiers in order to combine with numericals. In other words, these theories

of the mass/count distinction allow for all object denoting nouns in a language to be object mass. This contrasts sharply with the analysis of Chierchia (2010, 2015), which, as seen in the quote at the beginning of this thesis, predicts that classifier languages should have no object mass nouns. Rather than being object mass nominal predicates, Chierchia (2010; 2015) assumes that all nouns denote kinds in classifier languages and that these are type-shifted to countable predicates by classifiers. The only 'object mass nouns' in this sort of analysis would be noun+classifier compositions that display the characteristic properties of object mass nouns, a phenomenon which has not been recorded. The existence of object mass nouns in classifier languages tests these theories of the mass/count distinction in the sense that the presence of object mass nouns (those not resulting from noun+classifier composition) would show that the aforementioned theories are too strong or too weak depending on their predictions.

1.3 Overview of the dissertation

In this thesis, I explore the novel hypothesis that the amount of object mass nouns in a language is related to the amount of morphosyntactic environments sensitive to the mass/count properties of nouns. While not every language might have object mass nouns, those that do will have an amount of object mass nouns that relates to the amount of morphosyntactic environments sensitive to the countability of nouns in that language. The following chapter of this thesis, Chapter 2, presents the properties of object mass nouns discussed in analyses of the mass/count distinction, and I show how it is that object mass nouns are both similar to and different from other mass nouns. This chapter discusses how the term *object mass noun*, though accurate, can be misleading with respect to the properties of nouns in this class. In light of this data, Chapter 3 of this thesis reviews theoretical analyses of object mass nouns, namely their characterization in theories of the mass/count distinction, including those of Chierchia (1998a); Barner and Snedeker (2005); Rothstein (2010, 2017); Landman (2011, 2016); Schwarzschild (2011); Sutton and Filip (2016c,b, 2018); Filip and Sutton (2017) and Grimm and Levin (Submitted). Chapter 3 also reviews the predictions that follow from the respective theories, such as Chierchia's (2010) prediction that object mass nouns should only be found in number marking languages like English.

Chapter 4 presents my take in broad strokes, casting doubt on Chierchia's (2010) prediction that object mass nouns should only be found in number marking languages like English, motivating the hypothesis that the number of object mass nouns in a language corresponds to the number of morphosyntactic environments sensitive to the mass/count distinction in that language, and arguing that a theory of object mass nouns

rooted in non-disjointness and sensitivity to context not only captures the behavior of object mass nouns, but also accurately predicts the manifestation of object mass nouns across languages. This analysis is formalized in frames following Sutton and Filip (2019), who motivate a modified form of frame semantics. Fillmore (1976) provides the original proposal for frame semantics as an appeal to structured ways of interpreting perceptual, cognitive, and communicative experiences. The frames introduced by Sutton and Filip (2019) likewise encode the information from such experiences, and does so in a way that stays close to mainstream semantic theories.

To test this analysis against those of others (e.g. Chierchia 2010, 2015; Rothstein 2010, 2017), Chapters 5, 6, and 7 review the mass/count distinctions and claims about object mass nouns in Greek, Hungarian, and Japanese respectively. These languages are of particular concern because they constitute points at which theories of object mass nouns and the mass/count distinction diverge with respect to their predictions. Each of these languages will be shown to have an amount of object mass nouns that corresponds to the amount of morphosyntactic environments sensitive to the mass/count distinction in that language. Each chapter discusses the extent to which this data challenges the predictions of Chierchia (2010, 2015) and Rothstein (2010, 2017), and the fact that the data can be captured by a non-disjointness based analysis of the mass/count distinction.

Chapter 8 concludes this thesis with a summative discussion of the ways object mass nouns have put theories of the mass/count distinction to the test with respect to data from Greek, Hungarian, and Japanese. This chapter also summarizes the crosslinguistic patterns that are revealed in the comparison of English, Greek, Hungarian, and Japanese, showing that there is a correlation between the number of object mass nouns seen in these languages and the discussed number of morphosyntactic environments sensitive to the mass count distinctions in these languages. These numbers are aggregated by counting the respective numbers of nouns and morphosyntactic environments that are discussed in the body of work on the mass/count distinction in these languages. The correlation between these sets of numbers is taken as support for the hypothesis that there is a relationship between the amount of object mass nouns in a language and the amount of morphosyntactic environments sensitive to the countability of nouns. I provide some speculation as to why this correlation might exist, and I frame this speculation in terms of language acquisition. Finally, I will discuss outlying data that is not capture by a context sensitive theory of countability in which object mass nouns denote sets of non-disjoint individuated entities (Landman 2016; Sutton and Filip 2016c,b, 2018, 2019; Filip and Sutton 2017), and I will propose means by which previous analyses might be synthesized in order to account for as much of the empirical data as possible.

Chapter 2

Objects, mass nouns, and object mass nouns

As previously mentioned, the category that nouns like *furniture* and *cutlery* belong to has been given different names, across semantic analyses of the mass/count distinction, however, *object mass* seems to have been used the most (e.g. Barner and Snedeker 2005; Tsoulas 2008; Inagaki and Barner 2009; Erbach et al. 2017; Rothstein 2017; Sutton and Filip 2018; Bale and Barner 2018; Erbach et al. 2019; Sudo 2015). At the same time, Doetjes (1997) and Espinal (2010) have used the term *count mass* for these nouns, while Rothstein (2010) refers to these nouns as both *naturally atomic mass nouns* and *superordinate terms*, Chierchia (2010, 2015) and Alexiadou (2015) calls them *fake mass nouns*, Landman (2011) has used the term *neat mass*, and Grimm and Levin (Submitted) use *furniture nouns*.

While the different labels for this class of nouns are sometimes listed together, resulting in a sense of interchangeability, it has been the case that certain terminology is considered misleading. Landman (2011), for example, rejects the term *fake mass noun* on the basis that these nouns are appropriate in the same morphosyntactic environments as canonical mass nouns like *mud* and *sweat*. This argument brings to discussion the transparency of the label chosen for this class of nouns: *fake mass* is not transparent because it might lead one to believe that nouns like *furniture* and *cutlery* are not truly mass nouns, which is a position that few, if any, would take. A takeaway from this criticism of the term *fake mass* is that the choice of label for this class of nouns should serve as a means of easily identifying the class of nouns, without being misleading.

The most widely used term for the class of nouns in question, *object mass*, seems both transparent and innocuous: nouns in this class refer to objects and pattern with prototypical mass nouns. While this definition might seem simple, it nevertheless requires

definitions of both *object* and what it means to pattern with mass nouns. Depending on the definitions one assumes, different nouns will fit under the definition of object mass noun. For example, if one assumes the definition of *object* given in Soja et al. (1991) then a brick of gold would be defined as an object, because it is cohesive, bounded, and spatiotemporally continuous. Because gold is generally encountered in solid form with the above properties, *gold* might be categorized as an object denoting noun under this definition of *object*. This categorization would go against a number of semantic analyses of the mass/count distinction in which *gold* is assumed to be a substance denoting noun (Link 1983; Rothstein 2010; Chierchia 2010). With respect to patterning with mass nouns, if this notion is defined as behaving identically to other mass nouns in all grammatical environments, then *cutlery* would not be considered an object mass noun given there are grammatical environments in which these nouns do not behave like other mass nouns. For example, Grimm (2012) states that the quantifier *each* can distribute over *cutlery*, as in (2.1), but not other mass nouns—e.g. *rice* (2.2).

(2.1) The cutlery is fifty cents each. (Grimm 2012, p. 8)

(2.2) *Rice is fifty cents each. (Grimm 2012, p. 8)

These examples illustrate the fact that the definition of object mass cannot be taken as the simple paring of two pre-established notions, because the pre-established notions fail to delineate the class of object mass nouns. This chapter will review different possible definitions of objects and what it means to pattern with mass nouns, ultimately settling on the following definition: object mass nouns (i) are shown to denote objects that are not straightforwardly countable but sometimes semantically accessible via a battery of semantic tests, and (ii) pattern similarly, but not necessarily identically, to substance mass nouns across morphosyntactic environments. In the chapters that follow, this definition of object mass nouns allows recent data on Greek, Hungarian, and Japanese to be interpreted in such a way that these languages can be said to have nouns with the characteristic properties of object mass nouns despite the fact that the languages have typologically distinct morphosyntax. The presence of such nouns in these languages calls into question analyses that predict vastly different distributions of object mass nouns in Greek, Hungarian, and Japanese.

2.1 Patterning with mass nouns

Chierchia (1998a) lays out the following ten empirical properties that characterize the behavior of mass nouns and count nouns.

1. Availability of plural morphology
2. Distribution of numeral determiners
3. Obligatoriness of classifier and measure phrases for combining with numerals.
4. Some determiners occur only with count nouns
5. Some determiners occur only with mass nouns
6. Some determiners occur only with plurals and mass nouns
7. Some determiners are unrestricted
8. Independence of the distinction from the structure of matter
9. A (predominantly) count noun can be made mass
10. A (predominantly) mass noun can be made count

The morphosytnactic phenomena in 1–7 distinguish count nouns from mass nouns according to felicity in the environment. For example, Chierchia (1998a) (2.3) shows that plural morphology is acceptable on count nouns like *shoe* but not acceptable on mass nouns like *footwear* and *blood*.

(2.3) a. There are shoes in this store.
b. *There are footwears in this store.
c. *There are bloods on the wall. (Chierchia 1998a, p. 55)

The phenomena in 8–10, on the other hand, exhibit the relation between nouns and the entities to which they refer. Property 8, describes the fact the same entities can be sometimes be referred to with a count noun and a mass noun that are near synonyms, (2.4).

(2.4) a. shoes vs. footwear
b. clothes vs. clothing
c. coins vs. change
d. carpets vs. carpeting (Chierchia 1998a, p. 56)

This property is also exemplified across languages, for example, while *furniture* is a mass noun in English, it is a count noun in Italian: *mobile/i* ('piece/s of furniture').

Chierchia (1998a) states that, while the properties in 1–10 exemplify the mass/count distinction, there are other ways in which the distinction can be uncovered, for example

with respect to the scopal properties that bare mass nouns and bare plural count nouns share in English. Chierchia (1998a) asserts that these properties arise in a language whenever there is a mass/count contrast to be detected, though these properties will be subject to crosslinguistic variation: for example the distribution of bare nouns is different in Spanish and English.

Some of the ten properties that Chierchia (1998a) lists in characterizing the mass/count distinction, have been categorized at least since Quirk et al. (1985) as mass syntax and count syntax. Each morphosyntactic environment serves as a means of displaying the mass/count distinction in the sense that each environment distinguishes two sets of nouns: those that are felicitous and those that are infelicitous. For example, (2.5) shows that numericals can directly combine with nouns like *girls* and *chairs* but not like *mud* and *furniture*.

(2.5) a. three girls, three chairs
b. *three muds, *three furniture (Rothstein 2010, p. 346)

The set of nouns that can directly combine with numerical modifiers can be called count, while those that are infelicitous in this environment can be called non-count or mass. Given the set of felicitous nouns are *count*, direct combination with numericals is considered *count syntax*. In parallel to count syntax, there are several morphosyntactic environments that can be considered *mass syntax*, and there are other environments that are neither count syntax nor mass syntax given they sanction both mass nouns and count nouns.

In this section, I will discuss these morphosyntactic environments and the ways in which mass nouns and object mass nouns are distinguished. What will be seen is that object mass nouns do not strictly pattern like prototypical mass nouns in certain ways. While this is useful for distinguishing object mass nouns as a semantic class, it is problematic in the sense that it calls into question what it means for a noun to be mass, and how *mass* can be defined while maintaining the transparency of the label *object mass noun*.

2.1.1 Count syntax

Properties of the mass/count distinction that can be categorized as count syntax are the availability of plural morphology, direct composition with numerical determiners, and composition with determiners that occur only with count nouns.

The determiners that only occur with count nouns but not mass nouns are *every*, *each*, and *a*, which combine with singular count nouns, and *several, (a) few, many* and *both*,

which occur with plural count nouns. While this generalization typically holds, (2.6), it is not necessarily the case that these tests operate without exception.

(2.6) a. each/every/a book
b. several/few/many books
c. *every/several furniture(s) (Rothstein 2010, p. 347)

While (2.6) shows that *each* is only acceptable with count nouns as a determiner, recall that Grimm (2012) has shown that it can nevertheless distribute over nouns like *cutlery*, albeit not when a determiner, (2.1). Another example of *each* being used anaphorically with *furniture* might include (2.7) on the assumption that *furniture* here refers to more than cabinets and standing chests, though even examples as unclear as these are hard to come by in corpora.

(2.7) The furniture included wall-mounted cabinets and standing chests, each exquisitely worked and richly patterned. (COCA)

While (2.7) might be a contender for a natural example of *each* referring anaphorically to the objects denoted by an object mass noun, no other straightforward examples of such reference with the object mass nouns listed in the appendix were found in the BNC, COCA, or COHA. While further work is needed to investigate the robustness of pronominal *each* referring to the discrete entities in the denotation of object mass nouns, this sort of evidence supports the idea that the mass/count distinction is not necessarily a bipartite distinction, rather there are multiple semantic classes related to countability (Allan 1980; Grimm 2012; Sutton and Filip 2016a,c).

Another example of what might considered count syntax that also distinguishes object mass nouns from non-solid substance denoting mass nouns is felicity with the reciprocal operator *each other*. For example, Rothstein (2010) reports that it has long been known that the antecedent of a reciprocal must be a plural noun phrase in English (2.8), the same is not true in Brazilian or European Portuguese (2.9).

(2.8) a. The chairs stood on top of each other.
b. *The furniture stood on top of each other. (Rothstein 2010, p. 380)

(2.9) Mobília (dessa marca) encaixa uma na outra.
Furniture (of.this brand) fits one in+the other
'Furniture (of this brand) fits into each other.' (Rothstein 2010, p. 384)

Furthermore, object mass nouns like *furniture, cutlery* and *silverware* can take reciprocal operators like *each other* in at least some dialects of English, (cf. Rothstein 2011), while uncoerced substance denoting mass nouns like *water* cannot (2.11).

(2.10) a. Of course, furniture should complement each other, but don't get bogged down with making sure everything is a perfect fit.[1]
b. Place your cutlery next to each other, on the tablecloth, above your plate.[2]
c. I really love the compact design because it allows me to fit all my silverware next to each other.[3]
d. Sailboats in the raft and powerboats with tuna towers and outriggers should not be rafted directly together to prevent all that overhead hardware from slamming into each other (COCA)

(2.11) a. #It's easy to stack water on top of each other.[4]
b. #Water should complement each other.

With respect to the examples in (2.1), (2.7), (2.10) and (2.11), we have at least tentative evidence that object mass nouns—e.g. *furniture, cutlery*—do not grammatically pattern strictly with those like *rice* and *water* in certain dialects of English.

2.1.2 Mass syntax

The properties of the mass/count distinction that can be categorized as mass syntax are obligatoriness of classifiers in counting constructions and measure phrases for combining with numerals, and composition with determiners that occur only with mass nouns, e.g. (2.12).

(2.12) little/much, water, *little/much book(s) (Rothstein 2010, p. 347)

In addition to infelicity in count syntax, felicity in mass syntax serves to further distinguish mass nouns from count nouns. It does not seem to be the case, however, that every language has determiners that are only felicitous with mass nouns, as will be shown in

[1] McCarthy, Michael. (2009). *Log Home Living*, (26) 2. Active Interest Media, Inc.
[2] Raheja, Chinha. (2016). *The Fine Art of Fine Dining*. Partridge Publishing.
[3] https://www.amazon.com/OXO-Grips-Expandable-Utensil-Organizer/product-reviews/B000WJMM0U/ref=cm_cr_arp_d_paging_btm_next_2?pageNumber=2 accessed 19 March, 2019.
[4] This sentence improves significantly with plural morphology and a context in which portions of water can be easily stacked—e.g. cases of water bottles or water bottles being stacked horizontally in some sort of container.

subsequent chapters. Further tests are therefore necessary to distinguish mass nouns from count nouns.

The fact that mass nouns require classifiers in order to combine with numericals is considered a property of the mass/count distinction. Classifier phrases in English parallel those in classifier languages like Mandarin, introduced briefly in Chapter 1 and discussed in more detail in Chapter 7. Similar to the way in which Japanese requires classifiers for combining nouns with numericals, classifier phrases are required for combining mass nouns with numericals in English and other number marking languages.

Classifier phrases in English are typically assumed to include those that refer to countable individuals or portions as in (2.13).

(2.13) three grains of rice, two piles of wood, two stacks of hay
(Chierchia 1998a, p. 55)

The phrases *piece of* and *item of* can serve the purpose of specifying countable objects in English, (2.14).

(2.14) a. U.S. Customs and Border Protection says in February, **120 pieces of furniture** with a retail value of $720,000 were found to be in violation of trademark laws. (COCA)
b. She wished that her room was not so cold. It had **three items of furniture**: her black iron bed with the brass knobs, the dressing table with the wobbly leg and an orange crate standing upright in the corner under the sloping roof. (COCA)

Previous analyses of the mass/count distinction have, at least indirectly, made the claim that certain classifier constructions distinguish object mass nouns from other mass nouns. Several analyses of classifier languages assume that all nouns are mass in classifier languages (e.g. Chierchia 1998a, 2010; Rothstein 2010), but also assume that classifiers have selectional restrictions that pattern with the substance/object distinction, and in this way may or may not exhibit a mass/count distinction. Cheng and Sybesma (1999), argue that classifiers can be divided into two groups based on whether or not they can name the unit that a noun denotes—i.e. whether or not they occur with 'count' nouns. Based on the distribution of classifiers in these languages and the assumption that all nouns are mass in these languages, it could be argued that there is a distinction between substance mass nouns and object mass nouns that falls in line substance/object distinction.

Grimm and Levin (Submitted) have also indirectly argued that sortal classifiers distinguish object mass nouns by asserting that sentences like (2.15) exhibit the countability of the entities referred to by object mass nouns.

(2.15) Ed has two pieces more furniture than I do. (Grimm and Levin, Submitted, p. 4)

In (2.15), the presence of the counting construction with the classifier *pieces* is the means by which the cardinality of the objects in the extension of *furniture* is known to be dimension specification.

However, the classifier phrases *piece of* and *item of* are not strictly used for counting objects, rather, they can also be used to count portions of certain substances as shown in (2.16) (see also Sutton and Filip 2016b).

(2.16) a. When the dogs turned back, children stopped running and made a show of hurling **a few pieces of mud** at the retreating animals. (COCA)
b. The city is amazingly clean because the government hires hundreds of people that clean **every little item of dirt**.[5]

Unlike *mud* and *dirt*, the classifier phrases *piece of* and *item of* are rarely if ever used with nouns like *juice* and *water*, which refer to liquids. Reasons for this distribution across substance denoting nouns may include the semi-solid nature of mud and dirt, or the fact that these substances are not often encountered in portions divided into glasses or bottles.

One way in which sortal classifiers might be able to distinguish object mass nouns from substance mass nouns is by testing whether or not two objects can be called a single item or piece. For example, the sentences in (2.17) exemplify the idea that two distinct objects straightforwardly constitute a single, countable individual.

(2.17) a. The chair and ottoman were sold together as a single piece of furniture.
b. I only wanted a mortar but I had to buy both the mortar and pestle as a single piece of kitchenware.

While a similar example could be conceived for portions of *mud* or *dirt*, (2.18), maintaining the spatiotemporal continuity of the original bits requires an amount of mental gymnastics over and above that required for the entities in the extension of nouns like *furniture*.

[5] http://www.campingoncloudnine.com/5-days-in-turkmenistan/ accessed 19 March, 2019.

(2.18) Two bits of mud can be pushed together to form a single piece of mud.

It remains an empirical question whether or not two pieces of mud must lose their individual spatiotemporal continuity as distinct entities and be joined into a single entity with its own spatiotemporal continuity to be said to constitute a single piece of mud. If it is the case that two pieces of mud must be physically conjoined in order to be called a single piece of mud, but the same is not true for object mass nouns like *furniture*, then classifiers may serve as a means of distinguishing nouns like *furniture* from other mass nouns.

Sutton and Filip (2016b) note that granular mass nouns like *rice* and *sand* complicate the picture further since they too can be counted with sortal classifiers as in (2.19).

(2.19) Three grains of rice fell off my fork. (Sutton and Filip 2016b, p. 386)

While it is likely not the case that two grains of rice might be considered one grain of rice in certain contexts, it certainly seems more plausible that two pieces of rice might be considered one. In other words, though *rice* shares some properties of object mass nouns, namely in denoting discrete entities, it seems that these nouns also share some properties with substance mass nouns like *mud*, namely in denoting entities with a somewhat homogeneous properties. To simplify the discussion at hand, I set aside granular nouns an appeal to existing analyses (Chierchia 2010; Sutton and Filip 2016c, 2019, see e.g.).

The fact that English classifier phrases can be used in counting both objects and portions, parallels the use of classifiers like *ping* (CL_{bottle}) in Mandarin, which, as will be discussed in Chapter 7, have been argued to have both functions as well (Rothstein 2017). Furthermore, similar to the way that the distribution of classifiers have been discussed as a means of distinguishing object nouns from substance nouns in classifier languages (Chierchia 2010, 2015; Doetjes 2012), it seems like sortal classifier in English could be said to distinguish object mass nouns from other mass nouns as long as the object interpretations like those in (2.14) can be systematically distinguished from portion interpretations like those in (2.16).

2.1.3 Determiners that occur with all nouns

While certain determiners distinguish count and mass nouns with respect to infelicity, others, such as the definite article, occur with both mass nouns and count nouns in English. While both classes of nouns are felicitous with the definite article, there is

nevertheless a crucial difference in the type of reference that singular count nouns and mass nouns have, and this difference in reference is made explicit in this morphosyntactic environment. When singular count nouns occur with the definite article, reference is strictly singular unless a universal grinder interpretation has been coerced. (2.20), for example, can only refer to a single spoon, for example a large metal serving spoon that weights at least 100 grams, unless we are in some sort of context where several spoons have been ground up into pieces, though even in this context, the plural, *spoons*, might still be more natural.

(2.20) The spoon weighs 100 grams.

Object mass nouns like *silverware*, on the other hand, can refer to more than one individual when occurring with the definite article. (2.21) might refer to the same large serving spoon referred to in (2.20), or it might refer to a set containing a knife, fork, and spoon.

(2.21) The silverware weighs 100 grams.

Plural reference of a morphologically singular noun modified by the definite article, in contrast to singular reference, has been discussed as a property of mass nouns by Chierchia (1998a); Alexiadou (2011) and Erbach et al. (2019). This property, in tandem with others such as infelicity in counting constructions or infelicity with plural morphology, serves to illustrate a key characteristic of mass nouns that served, in part, as motivation for the analysis of the mass/count distinction in Chierchia (1998a) in which mass nouns and plural count nouns both denote sums of atoms, though mass nouns differ in that they also denote individual atoms.

2.1.4 Patterning similarly but not necessarily identically

Considering all of the above properties of object mass nouns as a battery of tests for whether or not a nouns is count or mass, the picture that emerges is such that it is not always the case that object mass nouns pattern identically to substance mass nouns.

As shown in Table 2.1, object mass nouns in English pattern with substance mass nouns in the majority of environments, though object mass nouns pattern like count nouns or they pattern differently from substance mass nouns in a few environments. Unlike count nouns, object mass nouns cannot be directly counted or occur with count determiners like *every, many, few,* and *each*. Like prototypical mass nouns, object mass nouns can

occur with mass determiners like *much* and *little*. However, there is some evidence in support of the claim that, like count nouns, object mass nouns can serve as a distributive share to *each* while substance mass nouns cannot. Furthermore, in some languages and dialects, object mass nouns, like count nouns, can occur with *each other* as a reciprocal operator while substance mass nouns cannot. Lastly, while count nouns do not occur with classifier phrases like *item of*, object mass nouns do and some substance mass nouns can albeit with a different set of properties.

Table 2.1: Count/mass comparison

Class	NUM+N	DET_{count}	DET_{mass}	$each_{indirect}$	*each other*
COUNT	✓	✓	#	✓	✓
OBJECT MASS	#	#	✓	✓	✓/#
SUBSTANCE MASS	#	#	✓	#	#

While not an exhaustive or the most detailed list of combinatorial properties, this table shows the overall tendency of object mass nouns to pattern with substance mass nouns.

This table also shows that categorizing object mass nouns as mass nouns is not possible under the assumption that object mass nouns and substance mass nouns pattern identically. Instead, a weaker assumption is necessary, namely that object mass nouns pattern similarly, but not necessarily identically, to substance mass nouns across morphosyntactic environments. This leeway allows us to maintain the position that object mass nouns are bona fide mass nouns despite the fact that they pattern with count nouns in some environments, and it also allows provides grammatical evidence of the idea that object mass nouns are a semantically distinct class of nouns. While this position is not necessarily controversial, it nevertheless shows that analyzing the mass/count distinction with respect to a battery of tests is necessary to understand the true extent to which the classes of nouns differ, since using one or two tests, like counting and/or plural morphology, will only show superficial differences. Using a battery of tests is particularly necessary when looking across languages which differ from English in two key ways: first, the overall number of available tests seems to be lower in some languages, and, second, certain test do not seem to exist in some languages—e.g. Greek and Hungarian may not have environments that sanction only mass nouns. Using a battery of tests is also important in classifier languages like Mandarin and Japanese in which nouns are generally not directly counted and plural morphology is not widely available.

2.2 Object mass reference

The previous section has shown that object mass nouns do not behave identically to substance mass nouns with respect to certain morphosyntactic environments, though

all mass nouns pattern similarly. This section reviews additional morphosyntactic environments that are not considered tests for the mass/count distinction, but nevertheless illustrate the distinction between object mass nouns and mass nouns like *sand, gold* and *dirt*. In analyses of the mass/count distinction, the distribution of stubbornly distributive predicates (Rothstein 2010; Schwarzschild 2011) and the quantity comparison tasks of Barner and Snedeker (2005) are often taken as the means of distinguishing types of mass nouns. These tests serve to characterize object mass nouns as a semantic class, though it will be shown that complications arise with respect to how the results of these tests are interpreted due to the fact that not all tests result in identical sets of nouns. Such complications provide a point of departure for testing theories of the mass/count distinction.

2.2.0.1 Distribution to objects

In his discussion of the mass/count distinction, McCawley (1975), argues that the felicity of nouns like *furniture* with adjectives that refer to size indicates that such nouns are individuated in some sense. Rothstein (2010) and Schwarzschild (2011) independently observe that certain mass nouns can be felicitously modified by certain predicates, like *big*, while others cannot. Rothstein (2010) provides the examples in (2.22) to illustrate the idea that *big* is felicitous with object mass nouns like *furniture*, and Schwarzschild (2011) gives the examples in (2.23) to show that *big, round, long* and *large* are members of a class of predicates that are infelicitous with *traffic* and substance mass nouns like *wine* and *snow*.

(2.22) a. The furniture in our house is big.
b. In a department store: 'The big furniture is on the third floor.'
c. To movers who are emptying the house: 'Please take the big furniture down first.'
d. 'Don't buy big furniture, the stairs are too narrow to carry it up.'
(Rothstein 2010, p. 360)

(2.23) a. ?The wine is big.
b. ?The snow is round.
c. ?The cocaine was long.
d. ?The traffic is large. (Schwarzschild 2011, p. 5)

The general idea argued for by Rothstein (2010) and Schwarzschild (2011) is that these predicates require the noun they modify to refer to a set of entities over which the

predicate can distribute. If a noun does not refer to entities that the predicate can distribute over then it is infelicitous with the noun. These characteristics have lead to the predicates in question being dubbed 'stubbornly distributive'.

2.2.0.2 Quantity comparison tasks

Barner and Snedeker (2005) show that object mass nouns can be semantically distinguished from substance mass nouns in quantity comparison tasks. Barner and Snedeker (2005) demonstrate this semantic distinction in three experiments that show that object mass nouns refer to entities that can be compared in terms of cardinality while substance mass nouns do not.

In the first experiment, adults and children were shown a series of scenes in which two characters each had a different number of entities of the same kind. One character always had three entities that were small in size, and the other character had one entity of the same kind that was larger in volume and surface area than the other three entities put together. Three categories of nouns were tested with their corresponding entities: count nouns like *shoes*, substance denoting mass nouns like *toothpaste*, and object mass nouns like *silverware*. Each scene was presented with a sentence that varied only with respect to the noun in question: *Who has more* N. The results of this experiment were such that everyone judged object denoting nouns in the same way, that is on the number of discrete objects in the scene, while substance denoting nouns were all judged according to volume.

The second experiment largely followed the set-up of the first, albeit with one significant change: instead of referring to one large object and three small objects, the object mass nouns referred to two large objects of different sub-kinds—e.g. *silverware* referred to a large knife and a large fork—in comparison with six small objects of the same two sub-kinds. In this experiment, object mass nouns again were compared with respect to cardinality of discrete entities rather than volume or area. This second experiment sought to remove any possibility that a single entity, e.g. a fork, did not constitute a good example of, e.g. *silverware*, which often refers to heterogeneous groups, e.g. knives, forks, and spoons.

The third experiment showed that participants use syntactic information to guide quantity judgments with respect to dual-life nouns like *stone* and *rope*. In this experiment participants were shown pictures of entities that can straightforwardly be referred to with the same noun in both mass and count syntax—i.e. dual-life nouns: *string, chocolate, paper* and *stone*. When given the plural noun in the quantity comparison question, participants almost always compared the cardinality of discrete entities, and when given

the bare singular, mass noun in the quantity comparison question, participants almost always compared the volume/surface area of the entities.

Barner and Snedeker (2005) and subsequent analyses of the mass/count distinction take the results of these experiments to indicate that object mass nouns and substance mass nouns are fundamentally different. Because of the different denotations of these nouns, object mass nouns are assumed to refer to objects whose cardinality can be compared despite the fact that they cannot be counted without a classifier.

While quantity comparison tasks are extremely useful in the sense that the ability to compare the referents of a noun according to cardinality can be taken as support for individuation and object mass reference, it is well known that the number of objects is not the only possible dimension of comparison when object mass nouns are used in quantity comparison constructions (McCawley 1975; Rothstein 2010, 2017; Scontras et al. 2017). Rothstein (2017), for example, argues that volume can be a relevant dimension for comparison of object mass nouns, as exemplified in (2.24), where it is assumed that John's furniture is smaller in cardinality but larger in volume.

(2.24) John has more furniture than Bill, so he should use the larger moving truck. (Rothstein 2017, p. 122)

In addition to volume, Grimm and Levin (Submitted) show that the function or event associated with a noun can be a relevant dimension of comparison as well. For example, in the presence of two sets of objects with identical cardinality, people sometimes judge one set to be *more* than another in a quantity comparison task. For example, a heterogeneous set of five pieces of furniture (a sofa, two chairs, a coffee table and a bookshelf) is judged to be more furniture than a set of five chairs. The basis used for this judgment is presumed by Grimm and Levin (Submitted) to be the ability of the objects in question to satisfy the event associated with the noun. With respect to the two sets of furniture, the assumption is that the heterogeneous set better satisfies the event associated with the noun *furniture*, furnishing a room, than does the homogeneous set, thereby explaining why the heterogeneous set can be called *more* furniture than the homogeneous set with identical cardinality. The number of possible interpretations of quantity comparison tasks serves to show that there can be uncertainty with respect to exactly what characteristic of an object mass noun is being compared. This uncertainty calls into question the exact nature of the difference between object mass nouns and mass nouns like *sand, gold* and *mud*. This question with be further explored in the following chapter.

2.2.0.3 Comparing tests for object mass nouns

Despite the fact that distribution to objects and cardinality comparison have both been assumed to be evidence of object mass nouns, it is not the case that these tests result in identical sets of mass nouns that refer to objects. In Schwarzschild's (2011) analysis, *furniture* and *luggage* are given as examples of 'mixed participant' nouns (those that correspond to both single participant events and multi-participant events), *wine* and *snow* are given as examples of 'multi-participant' nouns based on their respective felicity and infelicity with stubbornly distributive predicates. Though it could be the case, it is not clear if Schwarzschild's (2011) distinction between 'mixed participant' mass nouns and 'multi-participant' mass nouns could be said to be equal to the distinction between object mass nouns and substance mass nouns. One reason why the equality of these distinctions is unclear is because certain nouns that Schwarzschild (2011) describes as 'multi-participant' due to infelicity with stubbornly distributive predicates is a mass noun that refers to objects that may or may not be individuated in the sense of Barner and Snedeker (2005).

Traffic for example, is one 'multi-participant' noun that certainly requires objects to be present—cars, trucks, cyclists, etc.—though it is unclear if these objects would be compared according to cardinality in a quantity comparison task. Barner and Bale (2002) argue that traffic can easily be counted, suggesting that it should be considered an object mass noun: "Unlike substances such as water or glue, one could quite conceivably count the footwear or furniture in a room, or sit on the curb counting traffic" (Barner and Bale 2002, p. 785). The same can be said of other 'multi-participant' nouns, e.g. *lumber, timber, clutter, debris* and *rubble*, each of which could presumably be counted in terms of *pieces*. While each one of these nouns intuitively refers to objects and therefore might be susceptible to cardinality comparison, without these nouns being tested in a cardinality comparison task, it is not certain if they are lexically encoded more like substance mass nouns—e.g. *toothpaste*, *mustard*, and presumably $stone_{mass}$ and $rope_{mass}$—rather than like object mass nouns.

While the entities in the extension of *lumber* and *timber* might be considered objects in the sense of Soja et al. (1991), they bear a certain resemblance to the entities in the extension of nouns like *fence*, which Rothstein (2010, 2017) refers to as a *homogeneous noun*. *Lumber* and *timber* are similar to homogeneous nouns in the sense that, what counts as one fence, or one piece of lumber can be determined somewhat more arbitrarily than a piece of furniture. Similarly, given a sufficiently large entity in the extension of *lumber*, that entity can be divided somewhat arbitrarily in two and the predicates will generally still hold, unlike *furniture* where a piece like a vanity must be divided in a very

specific way (Sutton and Filip 2016a). These patterns are further reasons why one might argue that *lumber* and *timber* ought not be considered object mass nouns.

Semantic analyses of the mass/count distinction differ with respect to the treatment of object mass nouns like *furniture* and so-called 'homogeneous' mass nouns like *fencing* and *linoleum*. Rothstein (2010) assumes that object mass nouns and homogeneous mass nouns are distinguished with respect to natural atomicity: *furniture* refers to natural atoms, while *linoleum* does not, which would suggest that *linoleum* would not elicit a cardinality comparison in a quantity comparison task. Sutton and Filip (2016b), on the other hand, assume that both object mass nouns and homogeneous mass nouns are individuated, which would suggest that both could elicit a cardinality comparison in a quantity comparison task. If it is taken as a basic assumption that nouns that are compared according to cardinality comparison in such a task are individuated (or, for Rothstein (2010, 2017), denote natural atoms), and if *lumber, timber, clutter, debris* and *rubble* can be compared according to cardinality, then we would be forced to conclude that they are individuated. This would suffice to categorize these nouns as object mass in the analysis of Barner and Snedeker (2005). On the other hand if nouns like *lumber* can be compared according to cardinality, are assumed to be individuated, but are also assumed to belong to a different semantic class than object mass nouns, then individuation might be a necessary condition for object mass reference but it would not be sufficient, and an additional test or definition would be needed to define the sort of objects referred to by object mass nouns.

Like *traffic* and *timber* there are other mass nouns that share some characteristics of object mass nouns but have not been explicitly labeled as such. *Foliage, wildlife, company, parentela* ('relative' Italian), and *servitu* ('servant' Italian), for example are not explicitly labeled object mass nouns by Chierchia (1998a), though he groups these nouns that have been called object mass on account of the fact that they show inter- and intralinguistic variation with respect to countability.[6] While these nouns have not been subject to quantity comparison tasks, it seems that *foliage* and *wildlife*, at least, are felicitous with stubbornly distributive predicates, as shown in (2.25)

(2.25) a. Adding some big foliage to your garden is the perfect way to bring that party vibe home with you.[7]

b. For humans, wolves are about as harmless a species of large wildlife as there is. (COCA)

[6] See Table 3.1 for a comparison of the nouns that have been grouped together with those explicitly labeled object mass nouns.

[7] https://www.egardengo.com/blog/bold-foliage-makes-a-big-impact accessed 26 March, 2019

Despite felicity with stubbornly distributive predicates (in at least some dialects of English), it has been argued that *foliage* refers collectively to leaves and associated vegetation, and is not simply a mass equivalent to the count noun *leaves* (Grimm 2012), this and the fact that it does not fit the criteria that object mass nouns refer to artifacts (Grimm and Levin, Submitted) constitute two reasons why *foliage* might not be categorized as an object mass noun. Further work is therefore necessary to determine whether nouns like *foliage* and *wildlife*, and perhaps also *company, parentela* ('relative' Italian), and *servitu* ('servant' Italian) should be included or excluded from the class of object mass nouns.

Under the assumption that classifiers like *piece* can be used to distinguish object mass nouns from substance mass nouns, they would provide further support for classifying *foliage* and at least certain senses of *traffic* as object mass nouns given sentences like those in (2.26).

(2.26) a. To ensure the security of their network, we replaced their firewall with a unit that inspects every **piece of traffic** for viruses, spyware and intrusion attempts. (UKWaC)

b. Your bouquet will be carefully dismantled, with each bloom and **piece of foliage** being subject to separate preservation processes, designed to retain their original form and shape. (UKWaC)

As discussed in Section 2.1.2, however, these classifiers can also be used with certain substance nouns, e.g. *mud* and *gold*, which are widely held to be substance denoting mass nouns. This discussion also addressed the lack of empirical research definitively showing a distinction between the way in which these classifiers are used with nouns like *furniture* and the way in which these classifiers are used with nouns like *mud*. In lieu of such evidence, sortal classifiers alone cannot serve as a test for object mass nouns, though they could be used in a battery of tests that distinguish object mass nouns from other mass nouns.

While both quantity comparison tasks and stubbornly distributive predicates have been characterized as ways of distinguishing object mass nouns from substance mass nouns, the discussion of nouns like *traffic, lumber* and *foliage* has shown that these tests do not result in identical sets of object mass nouns. These results leave us with at least three options for defining object mass nouns: (i) we abandon stubbornly distributive predicates as a test for object mass nouns, using only the cardinality comparison test as originally done by Barner and Snedeker (2005), (ii) we accept the results of both tests and likewise accept that object mass nouns do not constitute a homogeneous class in the

sense that some object mass nouns can be identified via cardinality comparison but not stubbornly distributive predicates, while other object mass nouns can be identified in the opposite manner, or (iii) we accept only the set nouns that result from the intersection of the quantity comparison test and the stubbornly distributive predicate test, leaving some nouns in limbo until they have been tested in quantity comparison tasks and some nouns as outliers that do not properly fit into any other class.

While abandoning stubbornly distributive predicates would, in some ways, constitute a return to the original criteria for object mass nouns established by Barner and Snedeker (2005), this would not necessarily result in a clearer picture of which nouns are object mass nouns and which nouns are not, given the current state of research. Accepting only the intersection of the results of the two tests would not result in a clearer picture either. There are two reasons why the class of object mass nouns would remain unclear. First, quantity comparison tasks have not yet been conducted with nouns like *foliage, wildlife, company, parentela* ('relative' Italian), and *servitu* ('servant' Italian) meaning their status as object mass nouns would still be uncertain. Second, quantity comparison tasks involving nouns like *furniture* do not strictly result in cardinality based judgments, suggesting it is not entirely clear which semantic properties are being distinguished in a given quantity comparison task. In lieu of further research clarifying the above questions, I assume that a battery of tests can be used to distinguish object mass nouns from substance mass nouns.

2.3 Non-solid substances, solid substances, and objects

Chierchia (2010) characterizes nouns like *furniture* at least partly in terms of objects as they are defined by Soja et al. (1991): "The existence of non canonical mass nouns, like *furniture* (that clearly applies to objects in Spelke's et al.'s sense) shows that the mapping [between the grammatical basis of the mass/count contrast and the pre-linguistic categories] is non trivial" (Chierchia 2010, p. 102). For Chierchia (2010) at least one difference between object mass nouns and substance mass nouns is that the former denote objects (or stable atoms) while the latter denote substances or unstable individuals.

Like Chierchia (2010), semantic analyses of the mass/count distinction often make reference to the substance/object distinction characterized by Soja et al. (1991), and it is simultaneously well known that this distinction is not aligned with the mass/count distinction (e.g. Chierchia 1998a, 2015; Rothstein 2010, 2017; Grimm 2012; Sutton and Filip 2016b; Deal 2017; Filip and Sutton 2017, among others). Object mass nouns like *furniture* and *kitchenware* seem to be the most commonly discussed examples of the misalignment of these two distinctions, and being mass nouns that refer to objects, these

nouns exemplify the misalignment in question. It has also been discussed that nouns that refer to substances can be countable, though these examples seem to be fewer in number and are likewise less frequently discussed. Chierchia (1998a), for example, gives *puddles* and *clouds* as examples of count nouns that refer to substances. It is not clear, however, whether nouns like *puddle* and *cloud* are canonical count nouns, in the same sense as *cat* or *dog*, given the former are often used as classifiers accompanying mass nouns—e.g. *puddle of mud*, *cloud of exhaust*—while the latter are not.

Despite the misalignment between these two distinctions, the substance/object distinction is nevertheless still utilized as a sort of key-stone in analyses of the mass/count distinction. Sutton and Filip (2016b), for example, use the research of Soja et al. (1991) as the basis for having a semantic distinction between predicates for substances and those for objects, that distinction being whether or not a function that identifies countable individuals is present, as will be discussed in Chapter 3. Chierchia (2010, 2015), on the other hand, cites the fact that classifiers seem to be sensitive to the substance/object distinction as the means by which the mass/count distinction could be realized in classifier languages like Mandarin and Japanese, which suggests that in some languages the substance/object distinction is more or less aligned with the manifestation of the mass/count distinction. Rothstein (2010) makes use of the substance/object distinction to account for the difference in behavior of mass nouns like *water* and those like *furniture*, though she gives her own definition of substances and objects—or *natural atoms*—as will be discussed in Chapter 3.

This section explores the potential problems of assuming that the *object* part of the term *object mass noun* can be defined strictly in line with the definition of *object* given by Soja et al. (1991) in opposition to the definition of *non-solid substance*. In particular, I will discuss how the definition of *object* given by Soja et al. (1991) seems to be a necessary but insufficient condition for the entities in the extension of object mass nouns. In lieu of a sufficient definition of *object* as it pertains to object mass nouns, I argue for the use of a battery of semantic tests to uncover the sort of objecthood encoded in object mass nouns.

2.3.1 Differences between the subject/object and the mass/count distinctions

There are two key ways in which the notion of substance differs in semantic analyses of the mass/count distinction and the psycholinguistic studies. First, Soja et al. (1991) include granular entities like instant-coffee and orzo under the categorization of substances, while these entities and the nouns that refer to them have been treated as their own class in

certain semantic analyses (Grimm 2012; Sutton and Filip 2016a). Second, in semantic analyses of the mass/count distinction *substance* is used to describe solid substances like *gold* (Link 1983), while in Soja et al. (1991) *substance* specifically refers to non-solid substances, which would not include gold, at least in its most common state. These differences further illustrate the point that the mass/count distinction is independent from the structure of matter, and they also show that the way the structure of matter is discussed may vary from analysis to analysis. In discussing these two differences, this section shows that *object*, as it is used by Soja et al. (1991), is insufficient for delineating the types of entities referred to by object mass nouns as they are discussed in semantic analyses of the mass/count distinction, and therefore that semantic tests for the sort of objects referred to by the object mass nouns are crucial for defining this class of nouns.

The first disconnect between between semantic analyses of the mass/count distinction and the psycholinguistic studies of Soja et al. (1991) is that Soja et al. (1991) include nouns that refer to granular entities, for example *instant coffee* and *orzo*, in the class of substances while several semantic analyses have argued that these nouns exhibit different behavior than nouns like *water* and *mud* exhibit (Grimm 2012; Sutton and Filip 2016a, 2019). Grimm (2012) argues that grains of sand and rice can be characterized by the same mereotopological property as objects like dogs, namely they are maximally strongly self-connected. A maximally strongly self-connected entity is one in which every part overlaps with the whole and anything that overlaps with the whole is a part of the whole as well (see Grimm 2012, for a formal definition). Similarly, it could be said that a grain of sand is at least partially an object in the sense of Soja et al. (1991): it is cohesive, bounded, spatiotemporally continuous, and solid. While it is also true that a grain of sand moves as a connected whole through unoccupied space, it is not typically the case that grains of sand move independently of one another, and in this way, sand behaves like a substance, even though it is not necessarily the case that individual grains of sand do. Despite the fact that grains of sand and rice have some of the properties associated with objects, it is not the case that *sand* and *rice* are ever considered to be object mass nouns.

Sutton and Filip (2016a) argue that there are countable individuals in the denotation of granular nouns, though countability can be undermined because these individuals do not comprise the entirety of these nouns' denotations. This is supported by the fact that liquids are referred to with mass nouns across number marking languages, granular nouns show a degree of variation. For example *lentils* is count in English, but its Czech counterpart, *čočka* ('lentil'), is mass (Sutton and Filip 2016a). While Soja et al. (1991) do not assume that all substances have a corresponding mass noun, the data from Sutton and Filip (2016a) show that such an assumption could not be upheld because nouns that refer to granular entities are not always mass—e.g.*lentils, beans*—unlike nouns that refer

to liquids. This further illustrates the disconnect between the mass/count distinction and the structure of matter: it is not the case that all entities that would be considered substances by Soja et al. (1991) correspond to mass nouns. A result of this disconnect is that we cannot simply assume that all substances in the sense of Soja et al. (1991) correspond to mass nouns. To maintain a one-to-one correspondence between substances and mass nouns, an alternative definition of substances than that given by Soja et al. (1991) would be required to exclude granulars from this class of entities. While Soja et al. (1991) make no distinction between substances like clay and granulars like rice, some analyses of the mass/count distinction do make a distinction between nouns denoting these two types of entities (e.g. Grimm 2012; Sutton and Filip 2016a, 2019), resulting in a somewhat less clear substance/object distinction.

The second disconnect between semantic analyses of the mass/count distinction and the psycholinguistic studies of Soja et al. (1991) is the fact that certain nouns that generally are used to refer to solid entities are categorized as substance denoting nouns in semantic analyses despite the fact that they do not fit under the definition of substances given by Soja et al. (1991). Chierchia (2010), and Rothstein (2010), for example, include *gold*, which is generally solid, among the nouns that refer to substances, while the substances referred to by Soja et al. (1991) are strictly non-solid substances. Being a solid in its most common physical state, gold does not fit the definition of non-solid substances given by Soja et al. (1991), because it generally retains internal connectedness and external boundaries.

Despite the fact that the majority of gold fits the definition of object given by Soja et al. (1991), *gold* is never categorized as an object mass noun. The fact that *gold* and other material nouns like *aluminum* and *glass* are never characterized as object mass nouns is likely due to the fact that, as discussed by Link (1983) for example, these nouns commonly refer to materials that constitute countable individuals—e.g. a ring made of gold. Conversely, object mass nouns like *furniture* are not used to refer to a material that constitute countable individuals, rather they already refer to countable individuals as shown by the tests of Barner and Snedeker (2005). Despite the fact that gold is generally encountered in a solid form and these solid entities fit the definition of object given by Soja et al. (1991), which could lead to the assumption that *gold* is an object mass noun, there nevertheless is a crucial distinction between object mass nouns and mass nouns that commonly refer to the material that constitutes objects. In sum, *substance* as it is defined Soja et al. (1991) is quite different from the way it defined by semanticists like Link (1983).

What does not seem to have been tested, is whether or not *gold* might ever behave like an object mass noun in quantity comparison tasks like those conducted by Barner and

Snedeker (2005). The results of the dual-life noun experiment conducted by Barner and Snedeker (2005) suggest that *gold* would not be judged in terms of cardinality on the assumption that the lexical entry of *gold* is more similar to that of $stone_{mass}$ than that of *furniture*. While this is not necessarily surprising with respect to the semantic categories of substance mass noun and object mass noun, the fact that amounts of stone are generally not judged according cardinality in the presence of the mass noun does not align with the experiments of Soja et al. (1991), in which objects like stones typically elicit the same sort of behavior. Because stones are solid objects that hold their shape across space and time, and because they are judged according to volume by children and adults alike in the presences of mass morphosyntax, there is misalignment between what is considered an object versus a substance in the sense of Soja et al. (1991), and what is lexically encoded as object denoting in the sense of object mass nouns versus what is lexically encoded as substance denoting in the sense of substance mass nouns.

Assuming a natural distinction between substances and objects is not the only means of accounting for the differences between nouns like *gold* and *furniture*. As an alternative, one could assume that the difference between *furniture* and *gold* is not rooted in the perception of the objects referred to by these nouns, rather it is based in the lexical entries themselves. For example, this is possible in the analysis of Sutton and Filip (2016b) where 'object' nouns are those that contain an individuation function that results in the set of solid objects that can be counted as one, and 'substance' nouns are those that lack this individuation function and therefore do not denote a set of entities, substances or objects, that count as one. If this approach is taken, it must be remembered that having objects in the extension of a mass noun is not a sufficient condition for being an object mass noun: while it is true that every object mass noun refers to objects, it is not the case that every mass noun that refers to objects is an object mass noun. In lieu of definitions of objects and substances that straightforwardly give rise to the distinct behavior of nouns like *furniture* and *gold*, the relevant distinction, as initially proposed by Barner and Snedeker (2005) and also argued by Sutton and Filip (2016b), might be argued to be individuated versus non-individuated.

2.4 A battery of tests

In line with the way that Landman (2011) criticized the term *fake mass noun*, on the basis that nouns like *furniture* and *kitchenware* are genuine mass nouns, this section has taken a critical look at the term *object mass noun* and what it means for these nouns to be mass nouns that refer to objects in a particular way. *Object mass noun* is transparent in the sense that it accurately describes the general grammatical behavior of nouns in

this class and it accurately describes the physical properties of the entities referred to by these nouns.

However, this section has also shown that despite this transparency, it is not the case that all mass nouns that refer to entities that could be considered objects are to be considered object mass nouns in semantic analyses. This latter revelation shows that the term *object mass noun* is somewhat misleading, given it might lead one to believe that any mass noun that can refer to objects is an object mass noun. Referring to an object, as the term is used by Soja et al. (1991), is a necessary but insufficient condition for object mass nouns. It is therefore the case that semantic tests for the sort of object reference made by object mass nouns are crucial for defining this class of nouns. In other words, object mass nouns cannot simply be assumed to be mass nouns that refer to objects in the sense of Soja et al. (1991). Instead, object mass nouns are defined with respect to their behavior with respect to a battery of semantic tests, such as quantity comparison tasks and stubbornly distributive determiners.

The tests for object mass nouns and their results are summarized in Table 2.2, where STUB refers to stubbornly distributive predicates, $more_{CARD}$ refers to cardinality comparison in quantity comparison tasks, CL_{sortal} refers to the ability of sortal classifier phrases like *item of* to pick out countable individuals in the denotation of nouns, and $\text{Object}_{Soja\ et\ al.}$ refers to whether or not entities in the extension of the noun could be considered objects in the sense of Soja et al. (1991). In this table, # marks infelicity, × marks something that is not true or possible, ? marks something that is unclear, and ✓ marks something that is felicitous or true.

Table 2.2: Testing for object mass nouns

Class	STUB	$more_{CARD}$	CL_{sortal}	$\text{Object}_{Soja\ et\ al.}$
Non-solid substance—e.g. *water*	#	×	#	×
Granular—e.g. *rice*	#	?	✓	×
Solid substance—e.g. *stone*	#	×	✓	✓
Homogeneous object—e.g. *lumber*	#	?	✓	✓
unclear_1—*traffic*	#	?	✓	✓
unclear_2—*foliage, wildlife*	✓	?	✓	✓
Canonical object mass—e.g. *furniture*	✓	✓	✓	✓

As discussed in this chapter and summarized in Table 2.2, the picture of object mass nouns is not straightforwardly clear given the results of these tests. *Traffic*, perhaps, stands as the best example of how this picture is unclear: it is argued to be infelicitous with stubbornly distributive predicates, suggesting it is not object mass, and also to be comparable in terms of cardinality, suggesting that it is object mass.

While tests like quantity comparison tasks are sometimes assumed to be indicative of individuation (e.g. Barner and Snedeker 2005), it is not clear if this is a sufficient

characterization of object mass nouns. When it is the case that quantity comparison tasks are assumed to involve cardinality comparison, they are likewise assumed to indicate when objects are individuated—i.e. countable (Barner and Snedeker 2005). However, the experiments of Grimm and Levin (Submitted) show that quantity comparison tasks cannot always be straightforwardly assumed to be a test for individuated objects, given they sometimes seen to be a test for the function or associated event of the entities referred to by the noun in question. We therefore cannot assume that a quantity comparison in the presence of objects is a cardinality comparison indicative of individuation, if it is not a volume, weight, or other comparison of a physical dimension. This lack of clarity has only recently been seen to be a relevant characteristic of object mass nouns, however, and the availability of cardinality comparison remains as one of the fundamental tests in analyses of the mass/count distinction of evidence of object mass nouns and the basis for analyses of what it is that makes object mass nouns different from other nouns.

The lack of clearly delineated sets of object mass nouns and properties thereof might be taken as an indication that this class of nouns cannot be used as a testing ground for theories of the mass count distinction, contra Chierchia (2010) as quoted at the beginning of this thesis. It seems unclear how a theory of the mass/count distinction could account for a phenomenon that is itself somewhat unclear. The amount of leeway that exists in categorizing noun as object mass or not—e.g. *lumber, traffic, foliage*, etc—means that the notion might be vague or underspecified and therefore lack any true explanatory power, or it could mean that a theory is forced to take a position that delineates which nouns are object mass and which languages can have object mass nouns on theoretical grounds rather than empirical grounds.

Despite this seeming lack of clarity, tests such as stubborn distributivity are used as evidence of object mass nouns in certain languages—e.g. Greek (Alexiadou 2015)—and the availability of cardinality comarison is used in other languages—e.g. Japanese (Erbach et al. 2020)—and, based on these tests, theories about object mass denotations are proposed and make crosslinguistic predictions. The next chapter of this thesis looks at several theories of object mass denotations and the crosslinguistic predictions that these theories make. What will be seen is that theories make different predictions with respect to typologically distinct languages. A definition of object mass nouns that holds across these languages and studies is one in which object mass nouns are assumed to (i) pattern similarly, though not necessarily identically, to canonical mass nouns in morphosyntactic environments, and (ii) refer to objects that are semantically accessible in tests like quantity comparison or felicity of stubbornly distributive predicates. Crucially, not all languages need to have the same tests for countability or object reference available in order to be seen to have object mass nouns—e.g. Japanese only has very restricted plural morphology, yet it is argued by Sudo (2015) that nouns can be distinguished as count

or mass in different ways. Reviewing data from these languages will therefore use the possible presence of object mass nouns in these languages as a testing ground for theories of the mass/count distinction. What seems to be the case, as suggested by the data in this chapter, is that object mass nouns can exist in a language, so long as that language has a means of semantically and morphosyntactically distinguishing this class of nouns from others.

Chapter 3

Theoretical approaches to object mass nouns

Chapter 2 has shown that *object mass noun* is not a transparent label for a fixed set of nouns. Instead, depending on the criteria one chooses for defining this class, certain nouns will be included or excluded. For example if being *mass* requires that the noun is infelicitous in all morphosyntactic environments described as count syntax, then nouns like *furniture* and *cutlery* would be excluded from the set of object mass nouns on account of the fact that they can occur with reciprocal operators like *each other* in some languages and dialects. If referring to objects in the sense of Soja et al. (1991) is all that were required of mass nouns to be object mass nouns, then it would be the case that *gold* would have to be considered an object mass contra Link (1983); Rothstein (2010) and others, on the basis that it constitutes solid objects rather than non-solid substances in its typical form. If being infelicitous with stubbornly distributive predicates like *big* prevents a noun from being object mass, then *traffic, lumber* and other mass nouns would be excluded from this set. Generally, in formal analyses of the mass/count distinction, nouns like *gold, traffic,* and *lumber* are not considered to be object mass nouns, though *furniture* and *cutlery* are considered to be such.

Despite the complications that arise in giving a strict definition of object mass nouns, there have indeed been several proposals for how to treat object mass nouns formally. Some proposals make crosslinguistic predictions about whether or not object mass nouns should arise in a given language (e.g. Chierchia 2010, 2015), and other proposals argue that object mass denotations can account for the compositional properties of object denoting nouns in certain languages (e.g. Rothstein 2010, 2017). This chapter looks briefly at these theories and the predictions they make. This review of previous theories sets the stage for arguing for a particular analysis of object mass nouns in Chapter 4, and

for assessing the ability of these theories to capture natural language data from Greek, Hungarian, and Japanese in the subsequent chapters.

3.1 Characterizations of object mass nouns

Object mass nouns have come to the fore in semantic analyses of the mass count distinction since Chierchia (1998a), however, interest in object mass nouns can be traced back further. Early formal analyses of the mass/count distinction in Link (1983), Bach (1986), and Krifka (1989) discuss the relationship between the structure of matter and the classes of nouns that can and cannot be counted, though these analyses did not specifically address object mass nouns as a class with unique characteristics. Krifka (1989) might be considered an exception because he gives an analysis of how *cattle* is counted, and *cattle* has been categorized as a mass noun by Rothstein (2017). However, Allan (1980) argues that *cattle* belongs in a class of its own given its unique distributional properties. Following the argument of Allan (1980), the analysis of Krifka (1989) lacks a true discussion of object mass nouns.

The present chapter gives an overview of how and why object mass nouns have become so prominent. Chierchia (1998a) discusses the presence of object mass nouns with respect to one of the properties of the mass/count distinction, namely the fact that nouns in this class exhibit the independence of the mass/count distinction from the structure of matter. Since Chierchia (1998a), object mass nouns have played a central role in analyses of the mass/count distinction, precisely because (i) they refer to objects but do not grammatically pattern like the majority of nouns that do, and (ii) though they generally behave as substance denoting mass nouns do in morphosyntactic environments, there are instances in which object mass nouns do not. As discussed in Chapter 2 for example, Barner and Snedeker (2005), show that while substance and object mass nouns have the same morphosyntax in *more than* comparisons, object mass nouns are compared according to cardinality, while substance mass nouns are not. With this evidence, Barner and Snedeker (2005) analyze object mass nouns as lexically distinct from both count nouns and substance denoting mass nouns because of their patterns of behavior. Landman (2011), on the other hand, shows that the individuals in the denotation of object mass nouns can be counted in multiple ways, while individuals in the denotation of count nouns can generally be counted in only one way. Formalizing this notion provides a semantic explanation for why such nouns can be compared according to cardinality, but otherwise tend to display grammatically mass behavior. Since these initial semantic analyses of object mass nouns, further research has resulted in a number of different approaches including those of Grimm (2012); Sutton and Filip (2016b); Rothstein (2017);

Sutton and Filip (2017) and Grimm and Levin (Submitted). After reviewing theses theories, I compare the typological predictions that each theory makes in Section 3.2.

3.1.1 Inherent plurality of mass nouns: Chierchia (1998a)

The semantic basis for the mass/count distinction, according to Chierchia (1998a), is that mass nouns denote a complete join semilattice in which the difference between a single atom and a sum of atoms is neutralized; singular and plural count nouns make clear reference exclusively to atoms and sums of atoms respectively. Mass nouns are inherently plural despite the fact that they are not overtly marked as such with morphology. For Chierchia (1998a), object mass nouns, though he never calls them by that or another name, exemplify one of the properties of the mass/count distinction, namely its independence from the structure of matter, citing the substance/object distinction in the perceptual system of pre-linguistic children as defined by Soja et al. (1991). In characterizing this property of the mass/count distinction, he notes that many mass nouns refer to liquids, though nouns like *footwear* and *clothing* are exceptions given they are mass nouns that refer to objects.

The inherent plurality of mass nouns explains why mass nouns do not occur with plural morphology, according to Chierchia (1998a), who defines plural morphology as in (3.1).

(3.1) $\text{PL}(A) = {}^{*}A - A$

Chierchia (1998a) follows Link (1983) in using the * operation as the closure of atoms under sum, though Chierchia (1998a) does not follow Link (1983) in assuming that this operation corresponds to plural morphology. Instead, Chierchia (1998a) defines the operation that corresponds to plural morphology as the relative complement of the denotation of a predicate in its upward closure under *, thereby resulting in an exclusive plural—i.e. an interpretation of plural nouns that excludes singular individuals and denotes only pluralities. Because this operation, applied to a mass noun, would result in the empty set, Chierchia (1998a) argues, plural morphology cannot occur on mass nouns.

Chierchia (1998a) motivates an exclusive analysis of the plural on the grounds that the inclusive interpretation of plural nouns that occurs under negation ought to be accounted for in the analysis of *no* rather than in the analysis of plurals. For example, in (3.2-a), it cannot be the case that only one child lifted the piano, so (3.2-b) is contradictory if Alex is a child. While the readings of sentences like (3.2-a) and (3.2-b) are often taken as grounds for an inclusive analysis (e.g. Krifka 1989), Chierchia (1998a) takes a different approach. He argues that (3.2-c) only requires that no individual child lifted the piano,

and therefore should be able to be extended as in (3.2-d). However, Chierchia (1998a) claims, (3.2-d) appears to be contradictory and therefore is taken as grounds that the semantics of *no* is responsible for the problematic contradictions.

(3.2) a. No children lifted the piano.
b. No children lifted the piano but Alex did.
c. No child lifted the piano.
d. No child lifted the piano but Alex and Sam did.

Chierchia (1998a) recounts several benefits of this approach to the nominal domain. First is that the definite article is straightforwardly applied and interpreted the same way for singular nouns and for plural nouns. When applied to a singular noun, the definite article is true of one atom, and when applied to a plural, the definite article is true of the largest plurality—i.e. the largest sum of atoms. This, Chierchia (1998a) claims, accounts for the uniqueness requirement of the definite article. Another benefit is an explanation of the ungrammaticality of plural mass nouns: since mass nouns already denote a closure under sum of atoms, pluralization results in the empty set.

Chierchia (1998a) assumes a single atomic domain rather than two domains, one that contains atoms and one that contains not-necessarily atomic portions of matter as done by Link (1983). An argument that Chierchia (1998a) makes for an atomic domain is that mass nouns like *furniture* have atoms no less vaguely determined than those of count nouns like *chair* and *table*. Chierchia (1998a) further argues that, while having clear atoms the same is not necessarily true for mass nouns like *rice* or *water*, subdividing something always leads to a point at which sub-division can no longer occur, so *rice* and *water* must have semantic atoms just like *furniture*, *chair*, or *table*.

The atomic domain that Chierchia (1998a) assumes is the basis for counting. Numericals are treated as generalized quantifiers that are restricted to nouns to which the function SG can apply.

(3.3) For any set A:

$$\mathrm{SG}(A)\begin{cases} A, \text{ if } A \subseteq \mathrm{At} \text{ or if } A = \mathrm{PL}(B), \text{ for some } B \subseteq \mathrm{At} \\ \text{undefined, otherwise} \end{cases}$$

(Chierchia 1998a, p. 71)

The SG function checks whether its argument is a set of atoms (members of the set At) or is a plurality of a set of atoms built up from the pluralization operation PL. Because object mass nouns denote atoms but sums thereof are not made via the pluralization

operation PL, they are undefined with respect to SG, and therefore cannot be counted. Counting with mass nouns is still possible, however, with the use of an intervening classifier, like *bottle of* or *type of*, which functions as a means of type-shifting a mass noun to a count noun. In (3.4), the expression *type of* is a covert, two-place predicate that can be counted.

(3.4) A blood was singled out $\Rightarrow$ $\exists x$[type of(blood)(x)$\wedge$singled out(x)]
(Chierchia 1998a, p. 82)

In contrast to languages like English, later dubbed 'number marking languages' (Chierchia 2010), which have a class of nouns that can be directly counted, and a class of nouns that require a classifier to be counted, Chierchia (1998a) also discusses classifier languages—e.g. Mandarin—which require a classifier for counting all nouns. Chierchia (1998a) follows the analysis of Krifka (1995) in assuming that nouns in Mandarin denote kinds, though in Chierchia's (1998a) analysis, classifiers compose with nouns: nouns in Mandarin become mass nominal predicates via the operation π, which then become countable predicates by combining with classifiers. Numericals are quantifiers that can only take countable predicates, and composition of each of these occurs as in (3.5).

(3.5) liǎng zhāng zhuōozi (Chinese)
two CL table
'two tables'
liǎng(zhāng(π(zhuōzi))) (Chierchia 1998a, pp. 92-3)

The same syntax is seen with mass nouns in Mandarin (3.6), and because the same semantic analysis can be applied, Chierchia (1998a) suggests, there is no distinction between count and mass nouns in Mandarin, rather that all nouns are mass.

(3.6) a. yí lì mǐ
one CL rice
"one (grain of) rice"
b. liǎng lì mǐ
two CL rice
"two (grains of) rice" (Chierchia 1998a, p. 92)

Instead of having a distinction between count and mass nouns, Chierchia (1998a) argues, the extension of each noun in Mandarin is mass.

In sum, Chierchia (1998a) treats all mass nouns as denoting atomic semi-lattices. Despite making a notional distinction between mass nouns that refer to objects and those that

refer to substances, this distinction is not formally realized, and, as shown in Chapter 2, appealing to the substance/object distinction is insufficient for capturing the distinction between object mass nouns and other mass nouns. The resulting prediction is that object mass nouns and substance mass nouns should behave the same way.

3.1.2 Reference to individuals: Barner and Snedeker (2005)

While the analysis of Chierchia (1998a) predicts that object mass nouns and substance mass nouns should behave the same way, Barner and Snedeker (2005) show that this is not the case in quantity comparison tasks, as discussed in Chapter 2. Barner and Snedeker (2005) summarize three views on how mass/count syntax relates to linguistic individuation: (i) count nouns have a logical structure in which entities are individuated, while mass nouns do not (Quine 1960; Link 1983); (ii) count nouns specify individuals or atoms, and mass nouns refer to atoms and sums thereof (Chierchia 1998a) or entities that may denote individuals but only if specified by world knowledge (Gillon 1999); and (iii) count nouns correspond to construals of individuals, and mass nouns correspond to construals of unindividuated groups (Wisniewski et al. 1996). The question raised following this summary is "whether mass syntax has particular semantic requirements, or whether mass nouns, like count nouns, can be used to quantify over individuals" (Barner and Snedeker 2005, p. 47).

To answer this question and the developmental path that children follow in acquiring the mass/count distinction, Barner and Snedeker (2005) conducted the series of experiments described in Chapter 2. Barner and Snedeker (2005) argue that the results of these experiments are not straightforwardly compatible with the aforementioned theories of the mass/count distinction. The fact that object mass nouns received cardinality judgments cannot be accounted for in a theory where mass nouns have no individuated structure nor do they refer to construals of unidividuated groups. The analyses of Chierchia (1998a) and Gillon (1999) likewise cannot straightforwardly account for the results of the data since object mass nouns were compared according to cardinality, but dual-life nouns were strictly compared in correspondence with their overt grammatical marking: cardinality comparison for count syntax, but volume/surface area comparison for mass syntax. The idea here is that dual-life nouns refer to individuals that can be compared according to cardinality in count syntax, but these individuals are unavailable in mass syntax, unlike object mass nouns which have individuals available in mass syntax. In Chierchia's (1998a) account, there is no explanation as for why the atoms of object mass nouns would be available for cardinality comparison, but the atoms of the mass interpretation of dual-life nouns are not available for cardinality comparison.

Barner and Snedeker (2005) argue for a theory of the mass count distinction in which there are both lexical and syntactic origins of individuation. Count nouns and object mass nouns are associated with lexical concepts that supply a principle of individuation, though only object mass nouns lexically specify the [+IND] feature. Substance denoting mass nouns and dual-life nouns like *string* are unspecified with respect to individuation, [∅IND]. Additionally, count morphosyntax like plural morphology or the indefinite determiner carry specification of individuation, while mass morphosyntax is unspecified with respect to individuation. In sum, only object mass nouns are lexically specified as individuated, [+IND], while count noun lexical concepts supply a principle of individuation but do not specify it lexically, and substance denoting mass nouns supply no principle of individuation at all.

Barner and Snedeker (2005) assume that individuation can only be specified once in a given DP, thereby accounting for the interpretations that occurred in their experiments. Because count morphosyntax is specified for individuation, [+IND], and count nouns are therefore marked as individuated via plural morphology, in *more than* constructions, count nouns are compared according to cardinality. Because mass morphosyntax is unspecified for individuation, [∅IND], and substance denoting mass nouns are also unspecified for individuation, [∅IND], substance denoting nouns do not get cardinality interpretation with mass morphosyntax in *more than* constructions. Object mass nouns, however, being lexically specified as [+IND], bring this specification to *more than* constructions with mass morphosyntax, and are therefore compared in terms of cardinality.

In their closing discussion, Barner and Snedeker (2005) raise and attempt to answer the question "why some words become object-mass terms and others do not" (Barner and Snedeker 2005, p. 62). To answer this question, Barner and Snedeker (2005) report on the studies by Wisniewski et al. (1996) and Gordon (1985). Wisniewski et al. (1996) measured the reaction times of participants judging whether or not one or more nouns belonged to a particular superordinate category. The studies found that participants were faster to confirm that two nouns belonged to a superordinate category named by a mass noun than a count noun. They also found that participants judged the referents of a superordinate category named by a mass noun to be more likely to physically co-occur in the same space (e.g tables and chairs in the case of *furniture*) than the referents of a superordinate category named by a count noun (e.g. a lion and a tiger for *animals*). Gordon (1985) on the other hand showed that, when a group of objects is named by a nonce word like *garn* as in "Look at the garn", children are more likely to not pluralize the noun when using it themselves to refer to the group, though when a singular object is named by a nonce word, the children would pluralize it when referring to a group of the same objects later on. From these studies, Barner and Snedeker (2005) conclude that it may be the case that certain nouns become object mass because they (i) are

superordinate terms that (ii) refer to objects with high spatio-temporal contiguity. Their analysis is that it is the reference to a group of objects, as in the study by Gordon (1985), that physically co-occur in the same space, as in the study by Wisniewski et al. (1996), that make naming the objects with a singular term more likely. The leading takeaway from Barner and Snedeker (2005) that has been cited widely afterwards (e.g. Rothstein 2010; Chierchia 2010; Landman 2011; Champollion 2017; Filip and Sutton 2017, among others) is that object mass nouns refer to a set of objects that can be compared according to cardinality in certain contexts.

3.1.3 Natural atoms and sums thereof: Rothstein (2010)

As discussed in Chapter 2, Rothstein (2010) (independently of McCawley (1975) and Schwarzschild (2011)) shows that stubbornly distributive predicates, in addition to cardinality comparison, serve to distinguish mass nouns like *furniture* from those like *mud*. Rothstein (2010) focuses on a context based analysis of the mass/count distinction which is motivated by nouns that do not pattern with canonical examples of count nouns and mass nouns—e.g. *fence* and *furniture*. Her discussion of stubbornly distributive predicates is, therefore, limited to the fact that certain mass nouns are infelicitous with these predicates, while 'mass nouns like *furniture*' are felicitous. Rothstein (2017) argues that object mass nouns in general are felicitous with stubbornly distributive predicates.

As will be discussed in greater detail in Chapter 6, the mass/count distinction is a typal distinction according to Rothstein (2010, 2017). Mass nouns denote a semi-lattice and are type $\langle e, t\rangle$, while singular count nouns denote atoms and are type $\langle e \times k, t\rangle$, where k is a counting context that identifies countable individuals. The difference between object mass nouns and other mass nouns in this account is that object mass nouns refer to natural atoms. This definition of object mass nouns is somewhat similar to that of Barner and Snedeker (2005) in the sense that object mass nouns denote semi-lattices that are fundamentally different from the semi-lattice denoted by substance mass nouns. While Barner and Snedeker (2005) argue that grammatical systems are sensitive to whether or not a noun is individuated, [+IND], Rothstein (2010) argues that grammatical systems are sensitive to natural atomicity using data like that in (2.22) and that from the experiments of Barner and Snedeker (2005) as support.

(2.22) a. The furniture in our house is big.
b. In a department store: 'The big furniture is on the third floor.'
c. To movers who are emptying the house: 'Please take the big furniture down first.'

d. 'Don't buy big furniture, the stairs are too narrow to carry it up.'
(Rothstein 2010, p. 360)

Rothstein (2010) defines natural atomicity as in (3.7), asserting that this definition can be used to define naturally atomic mass nouns as well as naturally atomic count nouns.

(3.7) Natural atomicity:
If N is a naturally atomic predicate then:
$\forall x \forall k \forall k' [x \in \pi_1(N_k) \wedge x \in \pi_1(*N_{k'} \rightarrow \pi_1(N_{k'}))]$
'If N is naturally atomic, then for any two contexts k and k', if x is an atom of N_k, and x is in the denotation of $N_{k'}$, x is also an atom in $N_{k'}$'
(Rothstein 2010, p. 373)

Even though Rothstein (2010) contends that this definition of natural atomicity is supposed to account for the difference between mass nouns like *linoleum* and *water* and object mass nouns like *furniture*, which are all predicates of the same semantic type, $\langle e, t \rangle$, and denote a semi-lattice, the definition of natural atomicity does not seem to hold with respect to certain predicates that are notionally naturally atomic and objects in the sense of Soja et al. (1991). For example, consider the platter and bowl sum that might be used to serve appetizers at one's home—e.g. a selection of raw vegetables and some sort of dip, tortilla chips and salsa, etc. In (3.8-a), the sum of the platter and the bowl is referred to as a single dish, and is therefore an atom in the set $DISH_k$. In (3.8-b), the platter and the bowl are separate atoms in $*DISH_{k'}$. It is therefore not the case that the atom in $DISH_k$ is also an atom in $DISH_{k'}$, and therefore DISH is not a naturally atomic predicate.

(3.8) a. I like that the dish is two pieces which makes it easy to wash.[1]
b. The dishes were made in China.

This definition of natural atomicity also does not hold for certain mass nouns, for example *kitchenware*. As will be discussed in the section of this chapter on non-disjointness, the mass noun *kitchenware*, for example can be used to refer to the sum of six cups, six saucers, six dessert plates, a serving plate, a sugar dish with lid, a creamer and a teapot with lid, which would count as an individual item of kitchenware, namely a tea set, in context k. It is also the case that each of these items would be counted as individual items of kitchenware; lets call this k'. It is therefore the case that the tea set is an atom

[1]Both examples come from https://www.amazon.com/Portmeirion-Sophie-Conran-White-2-Piece/dp/B00BL07L3C/ref=lp_367207011_1_27?s=kitchen&ie=UTF8&qid=1553275186&sr=1-27 accessed 22 March, 2019.

in the set of KITCHENWARE$_k$ and it is set of *KITCHENWARE$_{k'}$, but it is not an atom in KITCHENWARE$_{k'}$. It is therefore not the case that *kitchenware* is a naturally atomic predicate, under this definition, and it should therefore behave no differently than *linoleum* or *water*.

To account for the behavior of nouns like *gold* that refers to the solid substance that constitutes objects, Rothstein (2010) assumes modified definition of substance to include solid materials that constitute artifacts: "mass nouns are associated with substances that take their spatial dimensions from containers (e.g. *water, mud*), or whose physical boundedness varies over time or depends on the artefact constructed from it (e.g. *wood, gold*)" (Rothstein 2010, pp. 343-344). By extending the definition of *substance* to include solid entities that are materials used in constructing artifacts, entities like stones, gold nuggets, and linoleum fall into the category of substance. In doing so, Rothstein (2010) provides an explanation for why these nouns are natural candidates for mass nouns.

While Rothstein's (2010) definition of substance solves the problem presented by *gold* and *stone*, this solution creates potential problems as well. First, the definition of substance and the definition of object are no longer mutually exclusive because an artifact can be constructed from objects, not only from substances. This has already been illustrated for stones and gold nuggets which are turned into walls and rings respectively. There is no reason, however, why Rothstein's (2010) definition of a substance could not also be extended to artifacts that are constructed out of other artifacts, for example, old bicycles that are repurposed and their pieces are turned into, among other things, chairs and tables. Once could say that such a chair is made from bicycle, but this is not necessarily the most felicitous way to describe the composition of a chair that is made from metal and rubber that used to be part of a bicycle. Nevertheless, it is true that the boundedness of the entity formerly called a bicycle now depends on the chair constructed from it, and therefore the bicycle fits under the definition of a substance given by Rothstein (2010).

Another potential problem with Rothstein's (2010) definition of substances is that the materials used to make artifacts are sometimes artifacts themselves. Assuming the definition of artifact given in the Oxford English Dictionary, (3.9), then even gold rings are technically made from artifacts if they are constructed from a bar of gold, or gold in some other form that has been refined from naturally occurring gold.

(3.9) Artifact: An object made or modified by human workmanship, as opposed to one formed by natural processes. (OED)

It is therefore the case that the entity, or in Rothstein's (2010) terms 'substance', that a gold ring is made from is a bar of gold rather than gold as it naturally occurs, and *bar of gold* would have to be considered, in this case, a mass noun.

The problem with Rothstein's (2010) definition of substance based on gold rings being made from artifacts might be seen as a quite pedantic analysis of the manufacture of a gold ring. One might argue that common knowledge tells us that a gold ring is made out of gold, not a bar of gold. This approach leads to a problem of its own, namely, it does not predict why a noun like *ore* should be mass when it refers to something that is generally solid but not used to construct artifacts. When ore is treated, the result is an entity referred to by a mass noun, e.g. gold, which is already assumed to be a non-artifact, even if formed into a brick that can be used to make artifacts like rings. If the gold entity that is used to make a ring is not an artifact, then the solid ore from which the gold was derived cannot be included in the definition of substance given by Rothstein (2010) because it does not constructed into an artifact. This is particularly problematic because *ore* cannot be referred to as an object mass noun either, and would therefore be a mass noun with unknown properties.

The definitions of substance and natural atom like those in Rothstein (2010) lead to problems, but they are nevertheless needed in her analysis to account for the different behavior of nouns like *furniture* and *gold* since they are both of the same semantic type, with uncountable number neutral denotations, yet they differ in that it is assumed to be the case that there are natural atoms in the extension of *furniture*, though not in the extension of *gold*. As seen to be the case in Chapter 2 with respect to the use of *object* and *substance* as defined by Soja et al. (1991) to distinguish between object mass nouns and substance mass nouns, the alternative definitions proposed by Rothstein (2010) are problematic when it comes to their ability to distinguish object mass nouns and substance mass nouns.

3.1.4 Underlying events: Schwarzschild (2011)

Avoiding the substance/object distinction entirely, Schwarzschild (2011) takes a very different approach from that of Rothstein (2010) to account for stubbornly distributive predicates. The categorizations of nouns argued for by Schwarzschild (2011) refer to the types of events that are assumed to underlie the meanings of nouns in Schwarzschild's (2011) event based analysis of the mass/count distinction. Multi-participant nouns include *wine*, *snow*, and *traffic* and are those that only apply to multi-participant events. Multi-participant events are those in which there is a set of, for example, nominal events, N, and a single predicative event **e'**, and all of the participants of N are all and the

only participant in **e'**. This same description applies to the collective interpretation of (3.10)—i.e when the sum of the boxes is considered large as spelled out in (3.11).

(3.10) The boxes are large. (Schwarzschild 2011, p. 3)

(3.11) There is a set of *box* events, B: COLLECTIVE
there is a *large* event, **e'**
the participants in the B events are all and only the participants in **e'**
(Schwarzschild 2011, p. 4)

For substance nouns like *wine*, the set of wine events are assumed to be sub-quantities of any given quantity of wine.

Multi-participant events contrast with single participant events, which, for example, have a predicative event, **e'**, for every event, **e**, in the nominal event, N. This description also applies to the distributive interpretation of (3.10)—i.e. when each box is large, as spelled out in (3.12).

(3.12) There is a set of *box* events, B. DISTRIBUTIVE
For every event **e** in B:
there is a *large* event, **e'**
the participants in **e** are all and only the participants in **e'**
(Schwarzschild 2011, p. 4)

Mixed events like *furniture* and *luggage*, are those that can be interpreted as both multi-participant events and as single participant events. Because multi-participant events can be interpreted as single participant events, they are able to be modified by stubbornly distributive predicates like *big* in the same way that *box* is modified by *large* in (3.12).

In summary, Rothstein (2010) and Schwarzschild (2011) independently observe that object mass nouns like *furniture* can be felicitously modified by stubbornly distributive predicates like *big*. From this observation, Rothstein (2010) assumes that nouns like *furniture* denote natural atoms that can nevertheless not be counted, thereby supporting her argument that the mass/count distinction cannot be defined in terms of the properties of the denotations of nouns. Schwarzschild (2011), on the other hand, uses the data to motivate an event-based analysis of the mass count distinction in which all count nouns are single participant nouns, while all other nouns are mass. While it is unclear what position Schwarzschild (2011) takes on object mass nouns, at least for Rothstein (2010,

2017); Alexiadou (2015) and others, the felicity of an stubbornly distributive predicate with a mass noun seems to serve as a test for object mass nouns.

3.1.5 Non-disjointness and overlap: Landman (2011)

In his analysis of the mass/count distinction, Landman (2011) offers a different perspective from Barner and Snedeker (2005) on why it is that certain nouns become object mass and others do not. Like Barner and Snedeker (2005), Landman (2011) focuses on the fact that languages with the mass/count distinction tend to have very similar sets of count nouns and mass nouns. He proposes that overlapping generators cause counting to go wrong and make nouns mass. Generators are assumed to be the entities that can be counted if they are not overlapping. For example, each cat in the extension of *cats* is a generator, and none of the cats overlap with respect to what counts as one *cat*. If generators do overlap, then counting is much more difficult as in the case of object mass nouns like *kitchenware* (where, for example, a tea set could be counted as several pieces of kitchenware or as one, and therefore overlap) and substance mass nouns like *water* (where molecules and the space around them can be divided up in multiple, overlapping ways). For these nouns, Landman (2011) argues, speakers do not make the choice between the various ways that the entities could be counted, so the noun's overlapping generators cause counting to go wrong.

Like Chierchia (1998a), Landman (2011) assumes a complete atomic Boolean algebra as the domain in which all nouns are interpreted. Landman (2011) proposes that the extension of a noun is an ordered tuple, $\langle N_w, \mathbf{gen}(N_w)\rangle$, where the first item is the noun intension N at world w, and the second item is the set of entities that could count as one N at world w, which is generated by the generation function on the noun, $\mathbf{gen}(N_w)$. Landman (2011) follows Link (1983) in using the * operation, though its use does not strictly correspond to plural morphology on plural count nouns. While the * operation is in the intension of plural nouns like *meubels* ('pieces of furniture', Dutch) but not *meubel* ('piece of furniture' Dutch), it is in both the intension and the set of entities that could count as one in the lexical entry of object mass nouns like *meubilar* ('furniture', Dutch).

(3.13) *meubel* → ⟨MEUBEL, MEUBEL⟩ with MEUBEL a disjoint set
meubels → ⟨*MEUBEL, MEUBEL⟩
meubeliar → ⟨*MEUBEL, *MEUBEL⟩ (Landman 2011, p. 35)

For Landman (2011), the difference between a plural count noun and singular count noun is whether the body is the closure under sum of the base or not, while a mass noun

denotes the closure under sum of both the intension and the set of entities that could count as one.

Counting, in Landman's (2011) analysis, has the criterion that the **COUNT** function is correct. The **COUNT** function "maps every regular noun intension N and world w onto a relation between elements of N_w and natural numbers" (Landman 2011, p. 29), and for this function to be correct, it must do so in every world w. The idea is that a count noun like *child* has an intension that determines a regular, disjoint set at every world: any given child will only ever be counted as one child. A mass noun like *salt*, Landman (2011) argues, having individual molecules that chemically composed of one sodium atom and one chlorine atom, does not have an intension that determines a regular, disjoint set at every world: many atoms of sodium and chlorine could be divided up into salt molecules in many different ways. The **COUNT** function is incorrect on the intension of *salt*, because it is not the case that any given salt molecule can be counted as one at every world: the sodium and chlorine that make up a particular molecule of salt in one world might each be in different molecules in another world. The **COUNT** function is incorrect on the intension of *kitchenware* for a similar reason, according to Landman (2011), namely that an entire tea set can be counted as one piece of kitchenware as can the teapot and each cup, saucer, comprising the tea set. This means that the set of countable entities in the denotation of kitchenware is not disjoint. Note that these facts cannot be accounted for in accounts of the mass/count distinction in which objects in the sense of Soja et al. (1991) or natural atoms (Rothstein 2010) constitute what counts as one.

The difference between count nouns and mass nouns is summarized in (3.14), where the **gen**(X) function, (3.15), identifies the set of entities in the domain that, via closure under sum, generate the denotation of a particular predicate.

(3.14) X is [+C], **count**, iff for every w: **gen**(X_w) is disjoint
i.e. the generators of X_w do not overlap
X is [-C], **mass**, iff for every w: if $|\, X_w \,| > 1$ then **gen**(X_w) is not disjoint
i.e. the generators of X_w overlap
(Landman 2011, p. 33)

(3.15) A *generating set* for X is a set **gen**(X) $\subseteq$ X-{0} such that: $\forall x \in X: \exists Y \subseteq$ **gen**(X):$x = \sqcup Y$
(Landman 2011, p. 22)

The entities that, when closed under sum, generate the denotation of a predicate are those that could be counted as one for a particular predicate—i.e. tea sets, cup and

saucer sums, and individual cups and saucers for *kitchenware*, and individual molecules of salt for *salt*. Landman (2011) summarizes the difference between object mass nouns, which he refers to as "neat" mass nouns, and substance mass nouns, which he refers to as "mess" mass nouns, with the definition in (3.16). The **min**(X) function returns the set of minimal elements of a particular predicate: the cups, saucers, teapots, etc. of *kitchenware*, and the molecules of *salt*.

(3.16) X is [+N], **neat**, iff for every w: **min**(X_{w}) is disjoint
i.e. the minimal elements of X_{w} do not overlap
X is [-N], **mess**, iff for every w: if $| X_{\text{w}} | > 1$ then **min**(X_{w}) is not disjoint
i.e. the minimal elements of X_{w} overlap
(Landman 2011, p. 33)

The object/substance distinction in the sense of Soja et al. (1991) is not addressed by Landman (2011), though he does make a distinction between neat mass (object mass) and mess mass (substance mass). The difference between object mass nouns and substance mass nouns, for Landman (2011) is whether the generators of a noun's denotation overlap (in the case of object mass nouns), or the minimal elements of the noun's denotation overlap (in the case of substance mass nouns). Landman's (2011) distinction between generators and minimal elements also provides a means of overtly encoding the difference between nouns that are synonymous except for their countability status like those in (3.13). *Meubel* ('piece of furniture' Dutch) refers to the minimal elements of the predicate MEUBEL, while *meubelair* ('furniture') refers to the generators of MEUBEL closed under sum.

Landman (2016) criticizes the choice of an atomic domain in his 2011 analysis, because it prevents the natural part-of relationship between, for example, a cat and a cat's paw, from existing in the mereological structure of the domain, because an atomic domain requires that a cat and one of its paws are both atoms. For this and other reasons, Landman (2016) does not commit to an atomic domain, and uses disjointness as the defining property of countable entities rather than atomicity. NPs, according to Landman (2016), still have an ordered tuple structure, though the components are different in the non-atomic approach. Recall that in Landman (2011), the first projection of the tuple is the noun's intension and the second is the set of entities that count as one. In Landman (2016), the first projection, the body, is the extension of the noun and a subset of the upward closure of the second projection, the base, and both are subsets of the domain. Count nouns have a disjoint base, which is used to generate countable sums in the body. Using the same pluralization operation from Link (1983), the body of plural count nouns is the set of entities that are the suprema of the subsets of X. Mass nouns have an

overlapping base in the sense of Landman (2011), though Landman (2016) revises the definitions of neat mass and mess mass by eliminating the definition of mess mass from Landman (2011) and assuming that these nouns are the complement of the set of neat mass nouns which generally follows the definition in Landman (2011).

By relying on disjointness for countability, Landman (2011, 2016) provides an explanation for why nouns are mass that is more explanatory than previous accounts than those like Chierchia (1998a) and Rothstein (2010) where the atoms denoted by mass nouns are simply uncountable, though Rothstein (2010) specifies they are uncountable because they are not indexed to a counting context. However, this approach is not without problems of its own, for example in respect to explaining why certain nouns are mass in one language and count in another. As Sutton and Filip (2016d) point out, it is not clear why *bean(s)* would be count in English and mass in Bulgarian, *bob* ('bean'). This analysis also falls short in respect to nouns like, *fencing* which would be treated as an object mass noun in such an analysis given its count counterpart *fence(s)*: because it does not meet the semantic criteria of having non-overlapping minimal generators, it cannot be classified as an object mass noun, and there is no sufficient explanation of its properties (Sutton and Filip 2016c). It is also unclear why it could not be said that molecules of any substance are the minimal elements relative to the predicate associated with that substance and since these molecule are disjoint at any given time, and therefore that mess (substance) mass nouns have minimal elements just like neat (object) mass nouns. There is, therefore, a sense in which even substance denoting nouns are neat mass nouns

Aside from leaving unanswered questions, Landman (2011, 2016) provides a novel characterization of object mass nouns. The characterizations of object mass nouns by Chierchia (1998a) and Barner and Snedeker (2005) include the idea that it is possible to count the objects referred to by object mass nouns, Landman (2011) contributes the idea that counting these objects, while possible, is not as straightforward as counting the object referred to by a count noun like *child*.

3.1.6 Context sensitive individuation and resistance to coercion: Sutton and Filip (2016b, 2018)

Sutton and Filip (2016b, 2018) argue that object mass nouns resist coercion in count syntax because of their lexical properties, the properties of unit extracting classifiers like *piece of*, and the fact that object mass nouns like *furniture* denote overlapping subkinds.

Sutton and Filip (2016b) synthesize the two distinct, but related, notions of context formalized in Rothstein (2010) and Landman (2011) in order to predict variations in countability, within a particular language and across languages. Recall that for Rothstein

(2010), count nouns denote entity-context pairs that comprise semantic atoms, and this context-indexing, allows her to capture how non-quantized count nouns like *fence*, are nonetheless countable: they denote (possibly different) sets of countable entities in different contexts. In Landman (2011), sets of entities that count as one are called *generator sets*, and count nouns have disjoint generator sets while mass nouns have overlapping generator sets. Sutton and Filip (2016b) argue that crosslinguistic patterns in the encoding of countability are the result of two functions on predicates, $P_{\langle e,t\rangle}$. The function $\mathbf{IND}_{\langle\langle e,t\rangle,\langle e,t\rangle\rangle}$ identifies a, possibly overlapping, set of individuated entities in the denotation of a noun, and the function $c_{\langle\langle e,t\rangle,\langle e,t\rangle\rangle}$ identifies what individuated entities are counted in a specific context, i.e., able to be subject to grammatical counting operation. Similar to Landman's (2011) variants, the c function can have different results for certain sets of objects. For example, take the set of things that count as "one" for *kitchenware* in c: $c(\mathbf{IND}(\text{KITCHENWARE}))$ (the counting base set for *kitchenware* at c). A mortar and a pestle could be in the counting base set when $c = c_1$, and their sum could be in the counting base set when $c = c_2$. With a specific counting schema, c_i, applied to X, the denotation will be maximally disjoint subset of X. However, with the null counting schema, c_0 applied to X, the denotation is a set of all, possibly overlapping partitions in X (which comes out as equivalent to X). So at the null counting schema (when $c = c_0$), the pestle and mortar sum, the individual pestle, and the individual mortar are all members of the counting base set which means that $c_0(\mathbf{IND}(\text{KITCHENWARE}))$ has members that are non-disjoint and not countable.

As in Landman (2011, 2016), grammatical counting is possible when the counting base is a disjoint set, c_i, but counting goes wrong when the counting base is an overlapping set, c_0. The (non-)resolution of overlap at counting contexts explains variation in mass/count lexicalization patterns for collective artifact nouns like *kitchenware* and *Küchengerät* ('(piece of) kitchenware', German). When these nouns are interpreted at c_0 they are mass, e.g. *kitchenware* (3.17), and when they are interpreted at a specific counting context, c_i, are count, e.g. *Küchengerät* ('(piece of) kitchenware') (3.18).

(3.17) $[\![\text{kitchenware}]\!]^{c_i} = \lambda x.\langle \text{KITCHENWARE}(x), \mathbf{IND}(\text{KITCHENWARE})(c_0)(x)\rangle$
(Sutton and Filip 2016b, p. 362)

(3.18) $[\![\text{Küchengerät}]\!]^{c_i} = \lambda x.\langle \text{KITCHENWARE}(x), \mathbf{IND}(\text{KITCHENWARE})(c_i)(x)\rangle$
(Sutton and Filip 2016b, p. 362)

The counting base of substances are also not disjoint and therefore cannot be counted. Sutton and Filip (2016b) also argue that predicates for substances and objects are semantically distinguished in their lexical entries. This is supported by the ability of

pre-linguistic infants to distinguish substances from objects (Soja et al. 1991). Formally, only object denoting nouns have the **IND** function in their lexical entries. Sutton & Filip therefore account for the fact that the notional distinction between substances and objects does not perfectly mirror the grammatical mass/count distinction in that the interaction of **IND** and c gives rise to the misalignment of these categories.

Unit-extracting classifiers like *piece of* are assumed to supply their own counting contexts to mass nouns via the substitution rule $[c_0/\varnothing \mapsto c_i]$ and to adopt the individuation schema from the counting base of the argument noun.

(3.19) $[\![\text{piece of}]\!]^{c_i} = \lambda P.\lambda x.\langle \mathbf{body}(P)(x), \mathbf{base}(P_{[c_0/\varnothing \mapsto c_i]}(x))\rangle$

(Sutton and Filip 2016b, p. 366)

When no classifier is explicitly stated, for example when counting three glasses of water with *three waters*, Sutton and Filip (2016b) assume that the argument noun's lexically provided counting schema is used, rather than assuming an implicit classifier contains the sort of substitution rule supplied by an explicit classifier like *piece of*. Because of this assumption and the fact that the lexical entry of object mass nouns contains a null counting schema, object mass nouns cannot be coerced/counted with an implicit unit extracting classifier. Substance mass nouns, on the other hand, can be counted with an implicit container classifiers because using the argument noun's lexically provided counting schema is not a problem: the implicit version of *glasses of*, like the explicit version, (3.20) will still denote a disjoint set.

(3.20) $[\![\text{glasses of}]\!]^{c_i} =$
$\lambda P.\lambda x.\exists y.\langle(\text{GL})(x),\ {}^*\text{IND}(\text{GL})(c_i)(x) \wedge \text{CONTS}(x) = y \wedge \mathbf{c\_base}(P)(y)\rangle$

(Sutton and Filip 2016b, p. 365)

Sutton and Filip (2018) set out to answer the question, why do object mass nouns resist coercion to subkinds while substance mass nouns like *water* and granular mass nouns like *rice* do not? They argue that this is caused by the fact that, subkinds of object mass nouns overlap at each level of categorization, while subkinds of other mass nouns do not. Levels of categorization, l_j are assumed to exist in the set of levels of categorization, $\mathcal{L}$, and include BASIC LEVEL categories, SUBORDINATE LEVEL categories, and subkinds. Superordinate count nouns like *vehicle* are assumed to be interpreted at a specific counting schema, (3.21), and is therefore countable with respect to kinds while object mass counterparts, like *transport*, are not. The kind readings of mass nouns like *furniture* and *rice* are interpreted at the null counting schema, c_0, so overlap prevents

counting object mass noun kinds, but counting substance and granular mass noun kinds is possible given they are disjoint as will be clarified with examples below.

(3.21) $[\![\text{vehicles}]\!]^{c_i,l_2} = \langle \textbf{vehicle}, \text{IND}_k(\textbf{vehicle})(l_2)(c_i)\rangle$

(Sutton and Filip 2018, p. 1209)

(3.22) $[\![\text{furniture}]\!]^{c_i,l_2} = \langle \textbf{furniture}, \text{IND}_k(\textbf{furniture})(l_2)(c_0)\rangle$

(Sutton and Filip 2018, p. 1208)

(3.23) $[\![\text{rice}]\!]^{c_i,l_j} = \langle \textbf{rice}, \text{IND}_k(\textbf{rice})(l_j)(c_0)\rangle$ (Sutton and Filip 2018, p. 1208)

For the kind **furniture**, the basic level is assumed to include **bed, chair** and **table**, while the subordinate level of **chair** includes **kitchen chair** and **dentist chair**. Subkinds of **furniture** include **bedroom furniture**, **kitchen furniture,** and **dining room furniture**. Each of these levels are argued to be overlapping and, therefore, uncountable at the null counting schema. For example, entities in the extension of **chair, desk,** and **mirror** are also in the extension of **vanity**, and chairs are in the extension of both **dining room furniture** and **kitchen furniture**.

For **rice**, one level of subkinds is assumed to be based on grain length—e.g. **long grain** and **short grain**—and another level of subkinds is assumed to be based on species—e.g. **basmati, jasmine,** and *arborio*. At every level, the subkinds are disjoint with respect to their extensions and are, therefore, countable even at the null counting schema c_0.

Because the counting base of **furniture** is not disjoint at the null counting schema, c_0, it cannot be coerced into a subkinds interpretation, for example, when occurring with the numerical modifier *three*, (3.24). However, because, relative to any level, the counting base of *rice* is disjoint at the null counting schema, c_0, it can be coerced into a subkinds interpretation with, e.g. plural morphology or direct composition with a numerical.

(3.24) $$[\![\text{three}]\!](\mathcal{K}) = \begin{cases} \langle \pi_1(\mathcal{K}), |\pi_2(\mathcal{K})| = 3\rangle & \text{presupposing } \pi_2(\mathcal{K}) \text{ is disjoint} \\ \bot & \text{otherwise} \end{cases}$$

(Sutton and Filip 2018, p. 1211)

Subkinds of **furniture** and other object mass nouns can be counted with an explicit subkind extracting classifier like *kind of*, which requires a specific counting scheme to select a disjoint set of subkinds.

(3.25) $[\![\text{kind of}]\!] = \lambda\mathcal{K}_{\langle k\times\langle k,t\rangle\rangle}\lambda c\langle\pi_1(\mathcal{K}),\pi_2(\mathcal{K})(c)\rangle$ (Sutton and Filip 2018, p. 1210)

A puzzle that Sutton and Filip (2018) point out in light of this analysis of English is why, in other languages, subkind interpretations of object mass nouns are sometimes possible. For example, *Gebäck* ('pastry' or 'baked good'; German) can occur in indefinite NPs and be interpreted as referring to a subkind of pastry.

(3.26) Ein Gebäck, das in der Osterzeit auf keinem Kaffeetisch fehlen darf,
A pastry REL in the Easter.time on no.DAT coffee.table lack.INF may.3SG
ist Marmoule.
be.3SG ma'amoul
'A type of pastry that is a must on any coffee table over Easter is ma'amoul.'
(Sutton and Filip 2018, p. 1198)

Sutton and Filip (2016c,b, 2018) provide with these overlap-based analyses an account for why nouns that refer to discrete individuals (*chair, dog*) are stably count and nouns that refer to substances (*water, mud*) are stably mass, while nouns that refer to collections of individuals (*shoes, footwear*) and homogeneous entities (*fence, rope*) show mass/count variation within and across languages. They are also able to give accounts of why it is the case that object denoting nouns might be mass (they are interpreted with respect to a null counting schema that denotes non-disjoint individuals) or count (they are interpreted with respect to a specific counting schema that denotes disjoint individuals) and of why it is the case that object mass nouns cannot be coerced into individual or subkind interpretations in English.

3.1.7 Associated events: Grimm and Levin (Submitted)

Grimm and Levin (Submitted) take an approach to object mass nouns that is more similar to that of Schwarzschild (2011) than it is to any other approach in order to account for the fact that object mass nouns can be compared according to non-physical properties in more-than comparison tasks. They argue that the countability of *furniture* and other object mass nouns is a property that is rooted in the nouns' 'artifactual' nature. Nouns that refer to artifacts are distinguished from those that refer to natural kinds following the long standing distinction drawn in Aristotle's *Physica*. For Grimm and Levin (Submitted) artifacts and natural kinds are distinguished on the basis that artifacts are characterized by function in associated events (Nichols 2008), while natural kinds are not. For example, pens are associated with writing events and furniture is associated with furnishing events. These writing and furnishing events are assumed to play crucial roles in the characterization of artifact nouns. A writing event is satisfied by a single

pen, and so *pen* naturally has singular reference. A furnishing event, on the other hand, is assumed to be canonically satisfied by many individual pieces of furniture, giving rise to the intuition that *furniture* refers to multiple entities. Grimm and Levin (Submitted) argue that reference to multiple entities provided no basis for a singular/plural contrast and results in mass encoding for such nouns.

Grimm and Levin (Submitted) argue that analyses in which nouns refer only to their constituent entities are insufficient and that an analysis based on associated events is necessary to account for the relevant data. This insufficiency is illustrated with quantity comparison tasks in which participants judge a heterogeneous set to be 'more' than a homogeneous set, despite the fact that both sets of equal cardinality of individuals. In the study, a set containing a sofa, two chairs, a coffee table, and a bookcase is judged to be more furniture than a set containing five chairs. An analysis in which nouns refer only to their constituent entities are insufficient because they cannot account for this judgment, rather such an analysis would predict that the cardinality must be judged to be equal. Instead, what helps to explain these judgments are comments from the participants, namely that the heterogeneous set can better furnish a room. The associated furnishing event, therefore can account for the comparison judgments—i.e. the set of entities that fulfills the function of furniture more completely is the set with more furniture.

Grimm and Levin (Submitted) provide empirical evidence in support of the assumption that object mass nouns are interpreted with respect to associated events. For example, they assume that being interpreted with respect to an associated event drives the tendency of artifact nouns to be named after their function in languages of the Americas (Brown 1999). For example, when a wooden box is referred to with a word that literally means 'wood sack', the fact that the box has a similar function to a sack is made explicit. Grimm and Levin (Submitted) argue that reference to function is also the case in examples like native words meaning 'shell' being extended to money: financial transactions are referred to because shells were used as a form of currency before coins and bills. In English, there is evidence of naming based on function as well, particularly in the realm of compounds, as observed by Downing (1977); Wisniewski and Love (1998) and Levin et al. (2016). For example, *coat hook, boat hook,* and *meat hook* each evoke the particular associated event/function of the kind of hook. Each of these examples are taken as evidence in support of the claim that artifacts are associated with particular events.

Further empirical evidence in support of the assumption that object mass nouns are interpreted with respect to associated events comes from a series of experiments conducted by Grimm and Levin (Submitted). The first followed the design of Barner and Snedeker (2005) where one set of entities had a larger cardinality and another set of entities was larger in other dimensions of comparison with the exception that the task was

verbal, rather than picture based, and participants were given a brief context for the comparison—e.g. *Two women are at a gala event... Who has more jewelry?*—rather than none at all. In this study, *ammunition, change, furniture, jewelry, luggage* and *mail* were all compared in terms of cardinality (≤75% of judgments per item) and in terms of function (≥25% of judgments per item). These results are assumed to suggest that cardinality is not the only available dimension of comparison. To test whether function/associated events might be an available dimension of comparison, Grimm and Levin (Submitted) conducted another experiment with the same general composition albeit with two different contexts for each object mass noun, one in which a comparison based on function was available and one in which a comparison based on function was neutralized. For example, comparing *furniture*, a function comparison is available in the context, *You are visiting different friends*, while function comparison is assumed to be neutralized in the context, *Different dealers bought furniture at an antiques auction.* The results were such that the number of judgments based on cardinality were much higher per noun in the function neutralized context. These results are interpreted as supporting the hypothesis that judgments based on function/associated events are possible for object mass nouns because these nouns are interpreted with respect to such function/associated events.

A control experiment tested whether or not it was merely the fact that the nouns in question are superordinate terms that gave rise to the flexibility in judgment. Grimm and Levin (Submitted) tested superordinate count nouns, *buildings, musical instruments, tools, vehicles, and weapons* in the same style of comparison task and found that certain comparisons were always done in terms of cardinality (*buildings* and *musical instruments*), while the other nouns were compared for cardinality more than 85% of the time. These results are assumed to suggest that being a superordinate term is not a sufficient condition for prompting comparisons based on function/associated event.

With these experiments taken as support for an analysis in which artifact nouns are interpreted with respect to an associated event, Grimm and Levin (Submitted) assume the countability of artifact nouns is rooted in the ability of the minimal associated event to be satisfied by one or more entities. For example, *cup* is a count noun because only a single cup can satisfy the minimal associated event in (3.27).

(3.27) $[\![cup]\!] = \lambda y[\text{ABLE}[x \text{ drinks out of } y \text{ in } e_{min}]]^{w,g,h_y,j}$

(Grimm and Levin, Submitted; p. 31)

(3.28) $[\![furniture]\!] = \lambda y[\text{ABLE}[x \text{ furnishes } y \text{ with } z \text{ in } e_{min}]]^{w,g,h_x,j}$

(Grimm and Levin, Submitted; p. 31)

Object mass nouns like *furniture* (3.28), on the other hand, can be mass because their associated events implicate the participation of multiple entities. Crucially, Grimm and Levin (Submitted) note that this generalization is a necessary condition for determining countability albeit not a sufficient one as exemplified by nouns like *chopsticks*, which are count, but nevertheless require a pair to satisfy the associated event.

In addition to cardinality and ability to satisfy an associated event, there are additional reasons why certain answers might have been given in their experiments. With respect to who has more furniture, it could be the case that the participants assumed the volume of the five chairs is lower than the volume of the heterogeneous set. Another possible explanation based on the analyses of Landman (2011, 2016) and Sutton and Filip (2016b), is chairs are judged to be one piece of furniture—i.e. a set of chairs—while the heterogeneous set is counted as five pieces of furniture.

A final explanation for the judgments of *furniture* in Grimm and Levin's (Submitted) experiments, is that it could be that subkinds of furniture are being compared, and the set containing only chairs is one kind of furniture, while the heterogeneous set contains more than one kind. This last possibility is not possible under the analysis of Grimm and Levin (Submitted), however, given they argue items like ***chairs*** and ***mirrors*** are not subkinds of furniture since there are kinds of mirrors that are not furniture. Sutton and Filip (2018), on the other hand, do assume that chairs are a subkind of furniture, and though their analysis is such that subkinds of furniture are not accessible in cases of coercion via direct numerical modification, there is no reason why this should prevent subkinds from being accessible in more-than comparisons.

Given the number of possible explanations for certain quantity judgments, satisfaction of associated events, cardinality of individuals, volume, and cardinality of subkinds, further empirical evidence is needed to elucidate which of these analyses has the most explanatory power, and which might be used to answer a given question. For example, it does not seem to be the case that the overlap based analysis of Landman (2011, 2016) and Sutton and Filip (2016b) can be upheld for all of the data in Grimm and Levin (Submitted). The experimental stimulus in (3.29) was responded to with more than half, but not all participants stating that woman B, the one with a larger cardinality of objects, has more jewelry. Grimm and Levin (Submitted) draw from participant responses, which give explanations like women A's jewelry is more elaborate and therefore more, to support their analysis based on associated events.

(3.29) **Goal:** Determine who has more
CONTEXT: Two women are at a gala event.
— Woman A is wearing two gold bracelets, a diamond tiara, and a ruby and

emerald necklace.
— Woman B is wearing three gold rings, a pearl necklace and a silver bracelet.
QUESTION: Who has more jewelry? (Grimm and Levin, Submitted, p. 13)

In order to maintain a purely overlap based analysis and account for this data, it would have to be assumed that at least three of the pieces of jewelry worn by woman B are counted as a single item, while all of the pieces of jewelry worn by woman A each count as individuals, so that woman B has only three individuals to woman A's four. While this is certainly possible, relies on individuation of jewelry that is not necessarily intuitive, given it is unclear which three pieces might function together as a single item.[2] A volume or weight comparison might account for the participants who judged woman A to have more jewelry than woman B.

With respect to (3.29), the most simple explanation seems to be that woman A is judged to have more jewelry than woman B, because the jewelry of woman A better satisfies the event associated with *jewelry*, (3.30).

(3.30) $[\![jewelry]\!] := \lambda z[\text{ABLE}[x \text{ adorns } y \text{ with } z \text{ in } e_{min}]]^{w,g,h_x,j}$
(Grimm and Levin, Submitted, p. 27)

The interpretation of *jewelry* occurs with respect to the ability, ABLE, of an entity z, the jewelry, to be used by an entity x in a minimal adorning event e_{min} of entity y. ABLE is a modality operator, (3.31), that incorporates property-level modality, (3.32), and allows entities not serving their intended purpose to nevertheless be referred to by the appropriate predicate.

(3.31) $[\![ABLE[(\hat{}P(x))]]\!]^{w,g,h_x,j} = 1$ iff $\exists w' \in W$ s.t. (i)-(iii) hold: (i) w' is accessible from w for d given h_x (ii) w' is maximally close to the ideal established by $j(w)$, and (iii) $\langle w', d\rangle \in [\![P]\!]$ (Grimm and Levin, Submitted, p. 31)

(3.32) *can* denotes a function v of type schema $\langle\hat{}\text{IV,IV}\rangle$ s.t. for any index w, any assignment g, any conversational backgrounds h_x, j, and any expression P of type $\langle\text{s,}\langle\text{e,t}\rangle\rangle$, $[\![v(\hat{}P)]\!]^{w,g,h_x,j} = 1$ iff $\exists w' \in W$ s.t. (i)-(iii) hold:
i w' is accessible from w for d given h_x, and
ii w' is maximally close to the ideal established by $j(w)$, and

[2] If the three rings belong to a set, they might count as one, though it is unclear why this assumption might be made without also assuming the two gold bracelets belong to a set as well, which would make the count equal.

iii $\langle w', d\rangle \in [\![P]\!]$

(Brennan 1993, p. 185)

Grimm and Levin (Submitted) define minimal events with respect to a predicate as those that are the smallest events that satisfy the predicate.

(3.33) *Minimal Event with respect to a predicate*:
$\min(e,P) = P(e) \wedge \neg\exists e'[e' < e \wedge P(e')]$ (Grimm and Levin, Submitted, p. 28)

While Grimm and Levin (Submitted) argue that object mass nouns are not countable because their associated events are satisfied by multiple entities, they argue that subkinds of these nouns are not countable for a very different reason, namely that these nouns fail to have a taxonomic hierarchy at all. Taxonomic superordinates, in the Roschian sense , are assumed to be hierarchically organized with an asymmetric set inclusion relation that defines mutually disjoint subkinds of a kind. *Vehicle* is uncontroversially a taxonomic superordinate because its subkinds are mutually disjoint, and every subkind—e.g. *car, boat*—stands in a hyponymic relation to the kind, *vehicle*. Grimm and Levin (Submitted) argue that artifactual aggregate nouns do not participate in well-formed taxonomies on the basis that their constituent entities have distinct associated events and their subkinds do not stand in hyponomic relation to the kind. The given example of this claim is that *furniture* is associated with furnishing events, while *chairs* are associated with sitting events which are not included in the set of furnishing events. Furthermore, while some mirrors could be referred to as *furniture*—e.g. a free-standing dressing mirror—not all mirrors can be referred to as furniture—e.g. a rear-view mirror—thereby illustrating the fact that *mirrors* as a subkind is not a hyponym of *furniture*. Grimm and Levin (Submitted) argue that it is this lack of taxonomic hierarchy that prevents subkinds of furniture from being counted.

This account predicts that the count/mass status of artifact nouns can vary across languages depending on the associated event. Grimm and Levin (Submitted) show that this prediction is borne out for *furniture*, whose French counterpart *meuble* ('(piece of) furniture') is count, but nevertheless refers to the same entities. Grimm and Levin (Submitted) argue that the associated event of *meuble* ('(piece of) furniture') stems from the origin of the word meaning 'move' and therefore is satisfied by single entities. Following Lammert (2014), Grimm and Levin assume that the *French* mass noun *mobilier* ('furniture') cannot simply be considered a mass equivalent to *meuble* ('(piece of) furniture), though they do not go into detail regarding a potential analysis of *mobilier* ('furniture').

While the associated events for nouns like *furniture* results in their categorization of mass nouns in this account, Grimm and Levin (Submitted) suggest that this is not the only way that such nouns might be grammatically distinguished. Rather than being mass or count, several artifactual aggregate nouns in Welsh fall into a third class of nouns which take singulative morphology to refer to individuals rather than an aggregate thereof. The crosslinguistic prediction borne out here is that nouns whose associated events are satisfied by multiple individuals will not necessarily be count or mass, but can comprise a third grammatical class instead given their semantics are distinct from both count and mass nouns. In other words, they specify the notion that, the unique set of properties had by nouns that are object mass in English can lead to these nouns being categorized in a unique way in other languages. This begs the question, what is it about Welsh that resulted in this third grammatical class that is different from English which resulted in these nouns being categorized as object mass.

3.1.8 Summary of characterizations of object mass nouns

Table 3.1 summarizes several characterizations of object mass nouns, generally those in English, starting with Gillon (1999) and Chierchia (1998a) who distinguish mass nouns like *luggage* and *furniture* on the basis that these nouns have countable counterparts within or across languages.

Table 3.1 shows that it is often the case the both cardinality comparison and stubbornly distributive predicates (STUBS) are taken as evidence of a class of object mass nouns. However, it is not the case that every noun proposed to belong in this class of nouns has been empirically shown to satisfy both tests. For example, *traffic* would not be considered an object mass noun with respect to stubbornly distributive predicates—according to Schwarzschild (2011), "The traffic is large" is infelicitous and therefore *traffic* is a multi-participant noun, unlike *furniture* which is a mixed-participant noun—yet Barner and Bale (2002) contend that the entities that constitute traffic can be easily counted. Despite the categorial dissonance exemplified by nouns like *traffic*, cardinality comparisons, stubbornly distributive determiners, and count counterparts are often assumed to be satisfactory tests for distinguishing object mass nouns from substance mass nouns.

Barner and Snedeker (2005) interpret the results of their study as an indication that object mass nouns refer to countable individuals. Reference to countable objects is also assumed to be illustrated by sentences like *Ed has two pieces more furniture than I do* (Grimm and Levin, Submitted), and, as discussed earlier, sortal/individual classifiers are also taken to be indicative of whether or not a noun refers to objects (e.g. Chierchia 2010,

Table 3.1: Summary: Characterizations of object mass nouns

Analysis; examples	**Category Name(s)**	**Characteristics**
Gillon (1999); luggage, footwear, traffic, company, laughter, foliage, wildlife, artillery		have count counterparts
Chierchia (1998a); hair, luggage, furniture, change footwear, carpeting, clothing parentela ('relative' Italian), servitu ('servant' Italian)		refer to objects, have count counterparts
Barner and Snedeker (2005); furniture, clothing, jewelry, silverware, mail	object mass nouns	cardinality comparison, have count counterparts
Chierchia (2010); furniture, mail, cutlery, footwear	fake mass nouns	have count counterparts, cardinality comparison (Barner and Snedeker 2005), STUBS (Schwarzschild 2011)
Rothstein (2010); furniture, jewelry, silverware	naturally atomic mass nouns, superordinate terms	have count counterparts, cardinality comparison (Barner and Snedeker 2005), STUBS (Schwarzschild 2011)
Schwarzschild (2011); furniture, luggage, mail, equipment	multi-participant nouns	STUBS
Landman (2011); furniture, kitchenware	neat mass nouns fake mass nouns	have count counterparts, cardinality comparison (Barner and Snedeker 2005), STUBS (Rothstein 2010)
Grimm (2012); furniture, cutlery	artifactual aggregates	cardinality comparison (Bale and Barner 2009), STUBS (McCawley 1975)
Sutton and Filip (2016b); furniture, cutlery, footwear, jewelry	collective artifacts (mass nouns : fake mass, object mass, superordinate mass)	have count counterparts, generally artifacts
Grimm and Levin (Submitted); baggage, beachwear, bedding, change, crockery, cutlery, footwear, furniture, hardware, jewelry, luggage, mail, silverware, ammunition	*furniture* nouns count mass nouns, object mass nouns, fake mass nouns superordinate terms	associated event, artifacts, cardinality comparison (Bale and Barner 2009), STUBS (Rothstein 2010) (Schwarzschild 2011)

2015; Doetjes 2012). Rothstein (2010) interprets the behavior of stubbornly distributive adjectives like *big* as an indication that object mass nouns refer to natural atoms as opposed to substances. Unlike Rothstein (2010), however, Schwarzschild (2011) interprets the behavior of stubbornly distributive predicates as indicative of whether or not the noun is associated with a single-participant event, which, with respect to mass nouns, may or may not correspond to object mass nouns. Landman (2011) assumes that object mass nouns are those whose generators are non-disjoint, and Sutton and Filip (2016c,b, 2018, 2019) and Filip and Sutton (2017) similarly assume that it is the null counting

schema applied to the set of individuated entities that constitutes the denotation of object mass nouns.

3.2 Typological predictions

Each of the aforementioned theories of object mass nouns and the mass/count distinction result in crosslinguistic predictions about the nature of these phenomena. There are several common themes among the semantic characterizations of object mass nouns within the theories of the mass/count distinction discussed above. Some of these characterizations are compatible across multiple theories while others are not.

The approach taken by Chierchia (1998a) and Rothstein (2010) are such that any noun that refers to objects (or natural atoms) could theoretically be an object mass noun so long as it is lexically encoded to denote a semi-lattice rather than atoms alone. This means that, crosslinguistically, it should be possible that object mass nouns are found among any class of nouns, and one should not necessarily expect to find object mass nouns primarily among nouns that refer to entities that occur in close proximity as argued by Barner and Snedeker (2005) or primarily among nouns that refer to individuals that overlap with respect to countability as argued by Landman (2011, 2016); Sutton and Filip (2016b,c, 2018, 2019) and Filip and Sutton (2017). In other words, the set of object mass nouns, in any given language, could be more or less random rather than centered around a group of nouns with certain conceptual properties.

This prediction of the theories of Chierchia (1998a) and Rothstein (2010, 2017) is considered particularly advantageous with respect to predicting the behavior of nouns in classifier languages. As has been reviewed in the previous chapters, nouns in classifier languages generally require classifiers in order to combine with numericals, and in this sense, every noun that refers to objects in classifier languages behaves like object mass nouns in number marking languages. Chierchia (1998a) and Rothstein (2010) assume nouns that refer to objects in classifier languages are object mass nouns when being counted, or at least when occurring in measure phrases (Rothstein 2017, p. 160), thus making use of the prediction that any noun that refers to objects can potentially be object mass.

The sort of approach to the nominal semantics of classifier languages taken by Chierchia (1998a, 2010, 2015) and Rothstein (2010, 2017) also predicts that all nouns that refer to objects should behave uniformly. In other words, there should be no set of nouns that refer to objects that behaves differently with respect to, for example, felicity with

determiners. In Chapter 7, recent work on reflexes in Japanese (Inagaki and Barner 2009; Sudo 2015; Erbach et al. 2017) will put these predictions to the test.

The analyses of Barner and Snedeker (2005) and Landman (2011) make complementary typological predictions about noun classes. The answer that Barner and Snedeker (2005) provide to the question why would a particular object denoting noun be mass, is that superordinate terms for groups of entities that occur in close spatiotemporal proximity to each other are susceptible to being object mass nouns. Complementing this explanation as to why certain object denoting nouns might be mass is the analysis of Landman (2011), who provides an explanation for why certain object denoting nouns would be count, and why substance denoting nouns would be mass. For Landman (2011), it is the fact that the distinction between (non)overlapping generators and the distinction between (non)overlapping minimal elements form two boundaries between noun classes both within and across languages. In other words, nouns like *chair*, whose generators are always considered to be disjoint, should be count across languages, and nouns like *salt*, whose minimal elements overlap across variants, should be mass across languages. Taken together, the predictions of Barner and Snedeker (2005) and Landman (2011) result in typological predictions about which nouns are likely to be count, which nouns are likely to be mass, and which nouns are likely to exhibit variation with respect to countability across languages.

The analysis of countability argued for by Sutton and Filip (2016b) predicts that nouns that refer to discrete individuals should be stably count across languages, nouns that refer to substances, liquids, and gasses should be stably mass across languages, while nouns that refer to collections of individuals or homogeneous entities will be subject to mass/count variation across languages. This single system, therefore, results in the same predictions made separately by Barner and Snedeker (2005) and Landman (2011). Differently, Sutton and Filip (2018) make no specific crosslinguistic predictions in their analysis of counting subkinds, though they note that there seem to be crosslinguistic differences. Extending the overlap based analysis of counting entities, the existence of overlapping subkinds should result in variation of counting subkinds across languages, depending on whether or not a noun is interpreted at specific counting schema or not. Potentially, a language could encode all nouns at specific counting schema and therefore allow the counting of subkinds to be coerced with an operation like that proposed for English by Sutton and Filip (2018).

Grimm and Levin's (Submitted) analysis based on associated events, like the analysis of Barner and Snedeker (2005), predicts which sort of object denoting noun is susceptible to being object mass. While Barner and Snedeker (2005) argue that the reason why certain nouns are susceptible to being object mass is the spatial proximity of the entities

referred to, Grimm and Levin (Submitted) argue that the underlying reason is that events associated with these nouns implicate the presence of multiple entities. Like Chierchia (1998a), Grimm and Levin (Submitted) leave open the possibility that all artifact nouns could potentially be mass so long as they can be interpreted with an event that implicates the presence of multiple entities. While Chierchia's (1998a) analysis simply seems to be a matter of lexical choice and extends to all nouns that refer to objects, Grimm and Levin's (Submitted) analysis is more nuanced in the sense that it only applies to artifacts and it requires the noun referring to a particular set of artifacts to implicate plural reference rather than being satisfied by only one entity.

The predictions of Chierchia (1998a), Barner and Snedeker (2005), Landman (2011), Sutton and Filip (2016b), and Grimm and Levin's (Submitted) are not straightforwardly compatible. Barner and Snedeker (2005) and Landman (2011) both predict that certain classes of nouns should exist cross linguistically, yet Chierchia (1998a) and Rothstein (2010, 2017) predict that a certain class of languages, namely classifier languages, generally have a single class of nouns, morphosyntactically speaking—that is, all nouns are in some sense mass. Despite Barner and Snedeker (2005) presenting evidence that object mass nouns are interpreted differently than substance mass nouns in comparison tasks, and despite the fact that Landman (2011) argues that a noun is mass if its minimal elements that can be counted as "one" overlap, both Barner and Snedeker (2005) and Landman (2011) present accounts of classifier languages in line with the analysis of Chierchia (1998a). Barner and Snedeker (2005) assume that individuation only occurs with classifiers, meaning that nouns are otherwise all lexically unspecified as is the morphosyntax. Landman (2011) treats all nouns in classifier languages as [-C], despite the fact that, by his own definition in (3.14), this is not expected to be true of nouns like *child*, which denote disjoint generators at all variants. Despite this tendency for analyses of classifier languages to assume that all nouns are, in some sense, mass, it is unclear why the original predictions of Barner and Snedeker (2005) and Landman (2011), as well as the predictions of Sutton and Filip (2016b, 2018) and Grimm and Levin (tted) (Submitted) should not still hold for classifier languages and those with any other characteristics unlike those in number marking languages like English.

The analyses of Schwarzschild (2011) and Grimm and Levin (Submitted) comprise a unique pair of perspectives on the mass/count distinction that are not necessarily incompatible with any of the other analyses. The idea that certain object denoting nouns become object mass because of close spatial proximity can be taken as a factor causing nouns to be interpreted in mixed participant events as proposed by Schwarzschild (2011) or why an associated event would implicate the participation of multiple entities as proposed by Grimm and Levin (tted). In a similar way, spatial proximity and mixed-participant (associated) events might be seen as a factor influencing the adoption of a

null counting schema in the analysis of Sutton and Filip (2016b), being interpreted with an overlapping generator set in the analysis of Landman (2011), or being interpreted as a semi-lattice rather than set of atomic individuals in the analysis of Chierchia (1998a). Further work on the potential synthesis of these accounts can shed light on the feasibility of such an approach.

In summary, in this chapter I have reviewed theoretical accounts of object mass nouns and the mass/count distinction and I have compared the crosslinguistic predictions that are implicated by the different theories. What is seen across all analyses is that object mass nouns have denotations that are distinct in some way from those had by count nouns and substance mass nouns. Analyses differ with respect to what it is about these denotations that is uncountable—e.g. they are not indexed to counting contexts (Rothstein 2010) or they denote sets of non-disjoint individuals Landman (2011, 2016); Sutton and Filip (2016b,c, 2018). The predictions that result from these theories are compatible in some cases, such as those of Barner and Snedeker (2005), Landman (2011), and Sutton and Filip (2016b,c, 2018) all predicting several classes of nouns across languages, though predictions are not straightforwardly compatible in other cases, for example Chierchia (1998a) and Rothstein (2010, 2017) who allow for all nouns to be mass as in classifier languages, while Sutton and Filip (2016b,c, 2018) predict that mass nouns can only arise among nouns that denote non-disjoint sets of individuals at the null counting schema. The next chapter lays out my own take on object mass nouns and motivates a novel hypothesis about their distribution across languages.

Chapter 4

Predicting the occurrence of object mass nouns

4.1 Hypothesis

In this thesis, I explore the hypothesis that the presence of object mass nouns in a language is related to the number of morphosyntactic environments sensitive to the mass/count properties of nouns in that language. I define object mass nouns as a semantic category that is characterized by two key properties: first, object mass nouns denote objects that are semantically accessible via a battery of tests such as quantity comparison tasks or felicity with stubbornly distributive predicates; second, object mass nouns are true mass nouns in the sense that they tend to pattern with canonical mass nouns like *mud* and *sweat*. While not every language might have object mass nouns, for those that do, the number of object mass nouns correlates with the number of morphosyntactic environments sensitive to the mass/count distinction in that language—e.g. count determiners like *each* and *many*, mass determiners like *much*, numerical determiners, etc. To the best of my knowledge, this idea has never been proposed. Of course, not all languages will have the same morphosyntactic environments available, so the set of environments that uncover object mass nouns will be language dependent; in English, for example, infelicity with plural morphology can be used to show that a noun is mass, though in Japanese, infelicity with plural morphology cannot be used to show that a noun is mass, so other diagnostic morphosyntactic environments must be established.

The relationship between the number of object mass nouns and the number of morphosyntactic environments sensitive to the mass/count distinction is visible in the comparison of English, Greek, Hungarian, and Japanese, languages that are from different language families and that have different nominal systems. While English has many object mass

nouns and likewise many morphosyntactic environments sensitive to the mass/count distinction, Greek, Hungarian, and Japanese have far fewer object mass nouns, if any at all, and likewise have far fewer morphosyntactic environments sensitive to the mass/count distinction—e.g. fewer count determiners, no strictly mass determiner, etc.. I argue that this hypothesis provides a useful perspective on crosslinguistic mass/count variation. The result suggests that whether or not a language has object mass nouns is not based on a single binary feature as proposed by previous accounts, namely the presence of number marking as argued by Chierchia (2010), and of strong number marking as argued by Chierchia (2015), but is the result of a more nuanced and complex relationship between morphosyntax and countability.

Though the data from the limited number of languages that I explore in this thesis supports the hypothesis that the number of object mass nouns correlates with the number of morphosyntactic environments sensitive to the mass/count distinction in a given language, there are many questions that follow. For example, is this correlation linear or more complex, for example having to do with a possible maximum number of object mass nouns and a possible maximum number of morphosyntactic environments sensitive to the mass/count distinction? If so, the possible maximum number of object mass nouns in a language varies with respect to theoretical analysis: under the analysis of Rothstein (2010), the number of object mass nouns can equal the number of object (or natural atom) denoting nouns, while under the analysis of Sutton and Filip (2016c,b, 2018, 2019) and Filip and Sutton (2017), the number of object mass nouns can only be as large as the number of nouns that refer to non-disjoint sets of individuated entities at their respective null counting schemas. A further question that follows from this thesis is whether or not the types of morphosyntactic environments sensitive to the mass/count distinction had by a language weighs on this correlation in some way. For example, in addition to appearing to have low numbers of object mass nouns, it seems that Greek, Hungarian, and Japanese do not have a unique determiner that is used only with mass nouns. These and similar questions that follow from this thesis will be further explored in Chapter 8.

The main hypothesis of this thesis contrasts with that of Chierchia (2010) stated in the quote at the start of this thesis. In this quote, Chierchia (2010) proposes that object mass nouns are restricted to languages that have obligatory number marking, which is defined in terms of stable atoms, thereby predicting that classifier languages, which lack obligatory number marking, have no object mass nouns. I cast doubt on this claim by drawing on data from Sudo (2015), who seems to imply that Japanese, a classifier language, has a mass/count distinction[1] that is uncovered in five morphosyntactic environments sensitive

[1] "In this paper, I argue against this view [that nouns in obligatory classifier languages have denotations that are somehow incompatible with direct modification by counting modifiers like numerals] by presenting

to the countability of nouns: four determiners that are only felicitous with count nouns, and large round numerical determiners that can combine with count nouns without classifiers. Preliminary results in (Erbach et al. 2017) show that these tests also suggest that Japanese has perhaps two to six nouns with the characteristic properties of object mass nouns. Together, the data from Sudo (2015) and Erbach et al. (2017) indicate that Japanese might, in fact, have object mass nouns, and therefore that, contra Chierchia (2010), obligatory number marking cannot be the sole determinant of whether or not a language has object mass nouns.

Chierchia (2015) modifies his 2010 claim in the presence of data from Greek, which has plural morphology that seems to occur freely on both count nouns and mass nouns Tsoulas (2008); Alexiadou (2011); Kouneli (2019), and therefore does not fit his 2010 definition of number marking, which has typological consequences for the presence of object mass nouns. Chierchia's (2015) modification to his 2010 claim is that languages with number marking defined in terms of stable atoms have strong number marking—e.g. English—while languages with number marking that is not defined in terms of stable atoms have weak number marking that can be applied to mass nouns—e.g. Greek. A consequence of this analysis is that Greek should have exactly zero object mass nouns, a prediction which seems to be borne out according to Tsoulas (2008) and Chierchia (2015). This number marking based rule for determining whether or not a language can have object mass nouns is not stated such that it should allow for exceptions, though there may, in fact, be some exceptions to this rule given the research of Alexiadou (2015) shows that Greek has two nouns with the characteristic properties of object mass nouns. The presence of at least two object mass nouns in Greek therefore constitutes a testing ground for Chierchia's (2015) theory of the mass/count distinction in the sense that this theory must be interpreted in such a way that allows for exceptions rather than making strict predictions about what can and cannot occur in a given language. Rather than assuming an analysis that must allow for exceptions, I argue that the number of object mass nouns correlates with the number of morphosyntactic environments in a given language, which seems to be borne out for Greek: the number of object mass nouns in Greek from Alexiadou (2015) is relatively small—two—as is the number of morphosyntactic environments sensitive to the mass/count distinction reported by Tsoulas (2008)—also two: numerical determiners and one count determiner.

Unlike Chierchia (2010, 2015), who argues that both count nouns and mass nouns are of the same semantic type, Rothstein (2010, 2017) follows Krifka (1989) in assuming that count nouns and mass nouns are typally distinguished. For Rothstein (2010), the

three pieces of evidence that Japanese has nouns (e.g. *hon* 'book') whose denotations are countable and perfectly compatible with modification by counting modifiers. I call such nouns *countable nouns*. Thus, as far as the denotations of nouns are concerned, Japanese is not so different from non-obligatory classifier languages" (Sudo 2015, p. 1).

means by which nouns are distinguished is whether nouns are lexicalized as mass nouns, and therefore denote a semi-lattice, which is not countable, or nouns are lexicalized as count nouns, in which case countable atoms are indexed to a counting context. Because this analysis presents no account of why a particular noun might be lexicalized as mass or count, it predicts that languages could have all mass or all count nouns. This is advantageous for Rothstein (2010) who analyzes all nouns in classifier languages as mass; in other words, all nouns that refer to objects are object mass nouns in classifier languages. This analysis should therefore be true of Japanese, however with the data from Erbach et al. (2017) and further experiments discussed in this thesis, I show that this analysis makes predictions that are too strong.

Rothstein (2017) and Schvarcz and Rothstein (2017) extend Rothstein's (2010) analysis of classifier languages to Hungarian, because classifiers occur in counting constructions with almost all nouns in Hungarian. These classifiers are optional, rather than obligatory as in classifier languages, and Hungarian also has hallmark characteristics of a mass/count distinction, namely numerical determiners, two count determiners, and plural morphology that only occurs on count nouns. Because Hungarian has characteristic properties of both classifier languages and number marking languages, Rothstein (2017) and Schvarcz and Rothstein (2017) analyze Hungarian as a 'mixed language' in which all countable nouns that can also be counted with a classifier have both a singular count and an object mass denotation, making them dual-life nouns. I shed doubt on this analysis of Hungarian on the grounds that Hungarian has at least three object mass nouns as well as at least three true dual-life nouns that exhibit mass behavior in a larger number of morphosyntactic environments than is shown to be the case for the nouns Rothstein (2017) and Schvarcz and Rothstein (2017) claim are dual life.

In showing that there is reason to believe that Japanese, Greek, and Hungarian each have a small number of object mass nouns that behave differently from other nouns that refer to objects in these languages, this thesis shows that Chierchia's (2015) prediction that object mass nouns should be restricted to languages with strong number marking, like English, is too strong. Instead, what is revealed is that these languages have relatively few morphosyntactic environments sensitive to the countability of nouns and are therefore very different from English, which has relatively many environments sensitive to the countability of nouns and likewise relatively many object mass nouns. These results support the main insight of this thesis, namely that there is a more nuanced and complex relationship between a language's mass/count morphosyntax and the number of object mass nouns in that language than proposed by Chierchia (2010, 2015).

4.2 Formal ingredients

In addition to casting doubt on the claims of Chierchia (2010, 2015) and Rothstein (2010, 2017), and showing that their analyses fail to make accurate and absolute predictions in light of new data pertaining to the existence of object mass nouns in Japanese, Greek, and Hungarian respectively, I show that an analysis in which countability is dependent on contextually determined disjointness (Landman 2016; Sutton and Filip 2016b,c, 2018, 2019; Filip and Sutton 2017) better motivates the relevant data in each of the relevant languages. As in the aforementioned analyses, I assume a single domain of non-atomic entities that is structured by the sum operation, $\sqcup$, an idempotent, commutative and associative relation, thereby taking the form of a complete join-semilattice (Krifka 1989). A single domain approach is a simpler and sufficient alternative to a two-domain approach (Bach 1986) and has been standard since Krifka (1989) though there are exceptions, for example Champollion (2017).

I assume that nominal roots have general number, therefore they carve out a complete join-semilattice that is a subset of the domain of entities. Recall from Chapter 1 that Espinal (2010) uses *general number* to describe lexical roots that express general meaning and have no reference to number. Sutton and Filip (2016c) use *number neutral* for the same purpose, while Espinal (2010) specifies number neutral predicates as nominal expressions that are unspecified for number. For example, the predicate DISH is a lexical root that denotes entities like bowls, platters, plates and sums of these entities.

$$\text{(4.1)} \qquad \text{DISH} = \left\{ \begin{array}{ccc} a \sqcup b \sqcup c, & & \\ a \sqcup b, & a \sqcup c, & b \sqcup c, \\ a, & b, & c \end{array} \right\}$$

Applying the individuation function to this predicate results in the set of individuated entities. By 'individuated entities', I mean entities in the extension of a predicate that have been identified by the individuation function as entities that can each be counted as 'one'. Following Sutton and Filip (2016c) I assume that knowing what sort of entity can count as 'one' with respect to a predicate is a pre-theoretic notion. Following Sutton and Filip (2016b), the presence of the individuation function is what distinguishes nouns that denote 'objects' versus those that denote 'substances' in a way that corresponds to but is not identical to the substance/object distinction as defined by Soja et al. (1991). For example bowls, platters, plates, and particular bowl+platter sums, as exemplified in Chapter 3, are each an individuated entity in the extension of *dish*.

$$\text{(4.2)} \qquad \text{IND(DISH)} = \{a,\ b,\ c,\ a \sqcup b\}$$

Following the analyses of Landman (2011, 2016), Sutton and Filip (2016b,c, 2018, 2019) and Filip and Sutton (2017), the sort of denotation in (4.2) is uncountable because it is non-disjoint; a disjoint set is defined as standard in (4.3).

(4.3) $DISJ(X) \leftrightarrow \forall x, y \in X[x \neq y \rightarrow \neg\exists z[z \sqsubset x \wedge z \sqsubset y]]$

It is among this sort of individuated predicate that object mass nouns can arise: when a number neutral predicate that denotes a non-disjoint set of individuated entities—e.g. IND(DISH)—is interpreted at a specific counting schema, c_i, it denotes a disjoint set of individuate entities, and is a count nouns, for example: *dish*.

(4.4) $c_i(\text{IND(DISH)}) = \{c,\ a \sqcup b\}$

If IND(DISH) is interpreted at the null counting schema, c_0, then it is a mass noun, for example *dishware*, that is, if it assumed that *dish* and *dishware* are assumed to share a lexical root, and therefore be synonyms in every respect except countability.

(4.5) $c_0(\text{IND(DISH)}) = \{a,\ b,\ c,\ a \sqcup b\}$

In addition to these formal ingredients, I follow Landman (2011, 2016); Sutton and Filip (2016b,c, 2018, 2019) and Filip and Sutton (2017) in assuming that the lexical entry of the noun comes in multiple parts, rather than a single predicate as assumed by, for example Chierchia (2010, 2015) and Rothstein (2010, 2017). Landman (2011, 2016) and Sutton and Filip (2016b,c, 2018) assume that the lexical entries of nouns have two parts, one that corresponds to the extension of the noun and one that corresponds to the countability of the noun (the counting base). This two-part lexical entry can also be seen as stemming from the analysis of Krifka (1989), in which count nouns have both a qualitative and quantitative component that similarly correspond to the extension of the noun and the cardinality of the noun. Landman (2011, 2016) and Sutton and Filip (2016b,c, 2018) differ in that Landman (2011, 2016) assumes that the counting base generates the extension while Sutton and Filip (2016b,c, 2018), whom I follow, do not. The formal ingredients assembled into this structure yield lexical entries with the form, $\langle extension, counting\_base \rangle$. For a singular count noun like *dish*, the counting base specifies a set of disjoint individuated entities, specified by the specific counting schema, c_i, on the individuation function **IND**, and the extension is equal to this set. A plural count noun like *dishes* differs from the singular in that the extension equals the closure under sum, *, of the set of disjoint individuated entities, specified in the counting base. A

mass noun like *dishware* corresponds to the plural albeit with the null counting schema, c_0 in both the extension and the counting base.

(4.6a) $[\![\text{dish}]\!] = \lambda x.\langle c_i(\mathbf{IND}(\text{DISH}))(x),\ \lambda y.c(\mathbf{IND}(\text{DISH}))(y)\rangle$

(4.6b) $[\![\text{dishes}]\!] = \lambda x.\langle {}^{*}c_i(\mathbf{IND}(\text{DISH}))(x),\ \lambda y.c(\mathbf{IND}(\text{DISH}))(y)\rangle$

(4.6c) $[\![\text{dishware}]\!] = \lambda x.\langle {}^{*}c_0(\mathbf{IND}(\text{DISH}))(x),\ \lambda y.c(\mathbf{IND}(\text{DISH}))(y)\rangle$

Filip and Sutton (2017) and Sutton and Filip (2019) extend this two part approach to streamline composition in the nominal domain, though general structure of the extension and counting base remain the same across analyses. As will be seen throughout this thesis, I primarily follow the sort of analysis presented here which corresponds to that argued for in Filip and Sutton (2017), though a third projection is added in this account, as said for the sake of simplifying nominal composition. In the conclusion I present the most recent edition of this analysis from Sutton and Filip (2019) in which lexical entries are formulated using a modified form of frame semantics, which builds on ideas from the original proposal for frame semantics by Fillmore (1975, 1976). This frame based approach is particularly well suited to accommodate modification and composition, and can straightforwardly incorporate information such as events associated with artifact nouns. Nothing hinges on the particular formal notation one might choose for noun denotations presented here.

In the analyses of Sutton and Filip (2016b,c, 2018, 2019) and Filip and Sutton (2017), it is expected that there is mass/count variation among nouns that denote a non-disjoint set of individuated entities, that is, the entities and sums thereof that can be counted as 'one'. If the result of this individuation function is non-disjoint, then this noun has the potential to be encoded as a count noun or an object mass noun depending on the sort of counting schema that is encoded in the lexical entry of the noun (Sutton and Filip 2016b,c, 2018, 2019; Filip and Sutton 2017). Following Sutton and Filip (2016c), a specific counting schema selects a disjoint set of individuated entities from the denotation of the individuated predicate, and the null counting context is essentially the identity function on the individuated predicate.

This set of assumptions leads to the prediction that there is a set of nouns that are stably count across languages, a set that is stably mass, and a set that is susceptible to mass/count variation given the result of the individuation function can be interpreted as disjoint or not depending on the counting schema applied to the set of individuated entities. If the individuation function applied to a predicate results in a disjoint set of individuated entities, then any counting schema, specific or null, will likewise result in a

disjoint set. In other words, if the individuation function applied to a root results in a disjoint set, then the nouns referring to this set of entities should be stably count across languages. Additionally, if the individuation function is not present in the lexical entry of a noun, as in the case of a noun referring to a substance, liquid, or gas, then there are no countable individuals at any counting schema, disjoint or not, meaning that the nouns referring to this set of entities should be stably mass across languages. Lastly, if the result of the individuation function applied to a root is non-disjoint and a specific counting schema is encoded, then the noun is countable given it denotes a countable, disjoint set. On the other hand, if this same individuated root that denotes a non-disjoint set is encoded with the null counting schema, then the denotation remains non-disjoint and this noun is mass. In other words, this analysis predicts that object mass nouns should only arise among nouns that denote a non-disjoint set of individuated entities when the individuation function is applied to the general number root.

This non-disjointness based analysis can account for the fact that, as will be shown in this thesis, Greek, Hungarian, and Japanese each seem to have a set of nouns that has the characteristic properties object mass nouns and denote a non-disjoint set of individuated entities when the individuation function is applied to the general number root. This analysis goes against the prediction of Chierchia (2010, 2015), that is, that Greek and Japanese should have no object mass nouns given they lack strong number marking. The analysis argued for in this thesis also goes against that of Rothstein (2010, 2017) which allows for (almost) all object, or natural atom, denoting nouns in Hungarian and Japanese to be object mass. In sum, the non-disjointness based approach to countability argued for by Sutton and Filip (2016b,c, 2018, 2019) and Filip and Sutton (2017) can capture the distribution of object mass nouns in English, Greek, Hungarian, and Japanese, while the analyses of Chierchia (2010, 2015) and Rothstein (2010, 2017) are shown to be too strong and too weak respectively.

4.3 Looking forward

In the following chapters of this thesis, I take in-depth looks into research on Greek, Hungarian, and Japanese and theories of the mass/count distinction that have been proposed to account for the data in the respective languages. These languages are of particular importance because their nominal systems differ in ways that constitute a choice point for theories of the mass/count distinction. Plural mass nouns in Greek, classifiers for count nouns in Hungarian, and a generalized classifier system in Japanese each constitute characteristics of nominal systems that force particular theoretical accounts, namely those of Chierchia (2015) and Rothstein (2010, 2017), to make distinct claims

about the presence of object mass nouns in these languages, for example that object mass nouns should not exist in Greek or Japanese (Chierchia 2015) and that (almost all) object denoting nouns have object mass denotations in Hungarian and Japanese (Rothstein 2010, 2017). The non-disjointness based analysis of Sutton and Filip (2016b,c, 2018, 2019) and Filip and Sutton (2017), on the other hand is such that it can be applied to Greek, Hungarian, and Japanese respectively, and in each case it makes the same prediction about the presence of object mass nouns in these languages, namely that object mass nouns can occur among nouns that refer to non-disjoint sets of individuals at the null counting schema. What this work will show in the following chapters is that, given evidence of nouns with the characteristic properties of object mass nouns in Greek, Hungarian, and Japanese, a non-disjointness based analysis captures the relevant phenomena in these languages, while the theories of Chierchia (2015) and Rothstein (2010, 2017) are seen to make predictions that are too strong and too weak respectively. Furthermore, it will be seen that the number of nouns with object mass properties in these languages corresponds to the number of documented morphosyntactic environments sensitive to the countability of nouns in the respective languages.

With respect to Greek, evidence that there are at least two nouns with characteristic properties of object mass nouns (Alexiadou 2015) constitutes a testing ground for theories of the nominal system in Greek. Chierchia (2015), for example, assumes that singular nouns must have singular reference, that the use of plural morphology cannot be semantically vacuous, and that the mass/count distinction generally corresponds to a distinction between stable atoms and unstable individuals. In English, these assumptions are taken to mean that singular and plural nouns are defined in terms of stable atoms, and that mass nouns are encoded as singleton properties—i.e. the sum of all P individuals. Because substances denote unstable individuals and are encoded as singleton properties to satisfy atomicity requirement of singular morphology, lexical choice makes it possible for object (stable atom) denoting nouns to choose to denote singleton properties. These assumptions about English neatly predict that mass nouns are morphologically singular and cannot take plural morphology, given it would be semantically vacuous on a singleton property, and that object mass nouns exist in English via lexical choice. Greek, on the other hand, is not assumed to have a requirement that either singular nouns or plural nouns denote stable atoms. This means that mass nouns denote unstable individuals rather than singleton properties. This predicts that mass nouns should freely pluralize (but remain uncountable, as they do, because counting is defined in terms of stable atoms), and that Greek should have no object mass nouns. The motivation for lexical choice, and therefore the existence of object mass nouns, is unclear in this account, and the claim that mass nouns refer to unstable individuals is problematic given it means that *nero* ('water') cannot be used to refer to all water in existence. Furthermore, the

evidence of at least two object mass nouns in Greek from (Alexiadou 2015) shows that Chierchia's (2015) analysis makes predictions that are too strong. In other words, an alternative analysis of Greek is desirable.

In Hungarian, there is evidence that there are at least three nouns with the characteristic properties of object mass nouns (Erbach et al. 2019), which therefore constitute a testing ground for theories of the mass/count distinction in Hungarian. Rothstein (2017) for example, assumes that nearly all object denoting nouns have an object mass denotation and a singular count denotation—i.e. are dual-life—in Hungarian. These assumptions predict that these object denoting nouns should be able to combine with individual/sortal classifiers in counting constructions, and that these nouns should be able to take plural morphology. However, the nouns shown to be object mass by Erbach et al. (2019) are shown to have mass behavior in environments like composition with the definite determiner, and the nouns claimed to be dual-life by Rothstein (2017) do not exhibit this mass behavior, though other dual-life nouns like *kő* ('stone') do exhibit this mass behavior. The justification for the object mass denotation of almost all object denoting nouns in Hungarian is therefore weak, as is the assumption that these nouns have a singular count denotation given they felicitously combine with numericals greater than ones. In other words, the data does not support the assumption that nearly all object denoting nouns have an object mass denotation and a singular count denotation—i.e. are dual-life—in Hungarian, contra Rothstein (2017). An alternative set of assumptions that can capture the Hungarian data would be beneficial.

Like Greek, it has been predicted that Japanese should have no object mass nouns (Chierchia 2010, 2015), and like Hungarian, it has been predicted that object denoting nouns that can be counted with sortal/individual classifiers have an object mass denotation (Rothstein 2010). These separate predictions are based on the nominal characteristics of classifier languages, namely that bare nouns are used as arguments, there is no obligatory number marking, and nouns generally require classifiers in order to be counted. (Chierchia 2010, 2015) assumes that nouns denote kinds in classifier languages and that there is no number marking defined in terms of stable atomicity. These assumptions predict the aforementioned characteristics of classifier languages (classifiers type-shift kind denoting nouns into countable predicates), and also predicts that there should be no object mass nouns. Rothstein (2010), on the other hand, assumes that all nouns are mass, therefore predicting the same nominal characteristics above, albeit in this case, the implication is that every object denoting noun is object mass. The presence of at least two to six nouns with the characteristic properties of object mass nouns casts doubt on both of the aforementioned analyses, suggesting that a novel analysis is needed for Japanese in order to account for a set of nouns that denote objects but behave differently from other object denoting nouns with respect to composition with count determiners.

In the chapters that follow, I show that a non-disjointness based analysis of the mass/count distinction accurately captures the fact that Greek, Hungarian, and Japanese each seem to have at least a small set of nouns that exhibit characteristic properties of object mass nouns and behave differently from other object denoting nouns and other mass nouns in these languages. The non-disjointness based analysis of Sutton and Filip (2016b,c, 2018, 2019) and Filip and Sutton (2017) predicts that object mass nouns should only arise among nouns that denote a non-disjoint set of individuals at the null counting schema, and this prediction is borne out across English, Greek, and Japanese given their candidates for object mass nouns denote non-disjoint entities at the null counting schema. I also discuss extensions to this sort of theory of countability that are necessary to account for, for example, plural mass nouns in Greek, and count nouns that take individual/sortal classifiers in Hungarian and Japanese.

In addition to showing these languages have a few object mass nouns, this thesis shows that each of these languages has relatively few morphosyntactic environments sensitive to the countability of nouns, as observed above in Section 4.1. In comparing the number of object mass nouns and morphosyntactic environments sensitive to the countability of nouns in Greek, Hungarian, and Japanese to those in English, this thesis reveals a pattern and possible causal relationship between the number of such environments in a language and the number of object mass nouns in that language. This data supports the hypothesis that the number of object mass nouns in a language is related to the number of morphosyntactic environments sensitive to the mass/count properties of nouns. The final chapter will discuss possible underlying causes of this relationship, and how to account for additional nominal characteristics discussed in this thesis while also capturing the cross linguistic manifestation of object mass nouns seen in this thesis.

Chapter 5

Greek

The existence of object mass nouns in Greek is somewhat controversial: it has been claimed that Greek has no object mass nouns by Tsoulas (2008) and Chierchia (2015), while Alexiadou (2015) claims that there are object mass nouns in Greek. Not only do Tsoulas (2008) and Chierchia (2015) claim that Greek has no object mass nouns, but their respective semantic analyses of the Greek nominal system predict that Greek should have no object mass nouns. These predictions are the result of the analyses of number marking in Greek argued for by Tsoulas (2008) and Chierchia (2015), which seek to account for the fact that mass nouns in Greek can take plural morphology and remain mass as in (5.1), rather than shifting to a countable kind or portion interpretation.

(5.1) Trehoun nera apo to tavani
Drip.3RD.PL waterPL.NEUT.NOM from the ceilingNEUT.SG
'Water is dripping from the ceiling'

(Tsoulas 2008, p. 133)

Tsoulas (2008) and Chierchia (2015) assume the analysis of object mass nouns argued for by Chierchia (2010) in which object mass nouns arise in a language that requires singular nouns to denote stable atoms and therefore has a means of encoding mass nouns as singleton properties. Mass nouns are assumed to denote a singleton property in English, for example, because singular morphology requires that singular nouns denote stable atoms, and because the individuals that mass nouns refer to are assumed to be unstable—i.e. sometimes atomic and sometimes not. It is also assumed that object denoting nouns like *furniture* can copy this behavior of choosing to denote a singleton property as a matter of lexical choice. Tsoulas (2008) and Chierchia (2015) argue that Greek does not have the requirement that singular and plural nouns must denote stable atoms, which allows mass nouns to take plural morphology and results in the prediction

that Greek has no object mass nouns. Alexiadou (2011), on the other hand, argues that plural mass nouns in Greek arise from lexical pluralization, which results in plural nouns with idiosyncratic meaning such as the 'much' inference that Greek plural mass nouns have been argued to have (Tsoulas 2008; Alexiadou 2011; Kane et al. 2015). This analysis of plural mass nouns in Greek leaves Alexiadou (2015) room to argue that Greek does have object mass nouns, which, in her Distributional Morphology based approach, are derived nominals. In this chapter, I will review the relevant Greek data pertaining to its mass/count distinction as well as previous accounts of number marking in Greek.

The data discussed in this chapter will show that there is reason to believe Greek has at least two nouns with characteristic properties of object mass nouns, and therefore that the analyses of Greek proposed by Tsoulas (2008) and Chierchia (2015) are too restrictive, though these analyses could be upheld with certain modifications. At the same time, it will be shown that the context sensitive, non-disjointness based analysis of Sutton and Filip (2016b,c, 2018, 2019) and Filip and Sutton (2017) predicts the occurrence of object mass nouns in Greek, though it requires extension to account for the occurrence of plural mass nouns in Greek. The presence of object mass nouns in Greek therefore constitutes a test for the theories of the mass/count distinction argued for by Chierchia (2015) and this thesis respectively, showing that the former makes predictions that are too strong, while the other does not. It will also be shown that, in addition to having relatively few object mass nouns, Greek seems to have relatively few morphosyntactic environments diagnostic of the countability of nouns.

5.1 The mass/count distinction in Greek

Greek has obligatory number marking and a mass/count distinction (Sioupi 2002; Tsoulas 2008; Alexiadou 2011, 2015; Chierchia 2010, 2015, among others). The Greek mass/count distinction can be uncovered by some of the standard tests discussed by Chierchia (1998a) and others, for example by seeing whether or not a noun can directly combine with a numerical without first being coerced. Despite being a number marking language with some of the key characteristics of a mass/count distinction, there are several ways in which Greek differs from number marking languages like English. Frequently occurring uncoerced plural mass nouns are one way in which Greek differs from other number marking languages, and another way that Greek differs from number marking languages like English is that bare singular count nouns can occur as predicates. Also, while English, uncontroversially has many object mass nouns, this class of nouns is much smaller in Greek, if it exists at all. This section will review each of these characteristics in turn.

As is typical in number marking languages, object denoting nouns like *molyvi* ('pencil') can directly combine with numericals like *dio* ('two') while substance denoting nouns like *laspi* ('mud') cannot straightforwardly combine with a numerical—i.e. they cannot combine with a numerical outside of a context that enforces a kind or portion interpretation.[1]

(5.2) a. dio molyvia
two pencil.PL
'two pencils'

b. #dio laspes
two mud.PL
#'two muds'

In this way, straightforward felicity in counting constructions reveals the mass/count distinction in Greek.

With respect to other tests for the mass/count distinction, Tsoulas (2008) provides the following comparison of English and Greek determiners according to their mass/count status:

Determiner type	**English**	**Greek**
Mass	*much, little*	*poli, ligo*
Count		
Singular	*every, a, each*	*kathe, enas*
Plural	*many, several, few, both*	*meriki*
Mass and plural	*all, a lot, plenty, most*	*poli, oli, perisoteri*
Unrestricted	*the, some, any, no*	*o/i/to, kapios, kanenas, arketos, kabosos, boikos...*

TABLE 5.1: English and Greek Determiners (Tsoulas 2008, p. 137)

Kathe ('every'), for example, is a count determiner, as shown by the fact that it cannot felicitously occur with the mass noun *nero* ('water') as in (5.3).

(5.3) *Kathe nero ine ahromo
every water is colorless
'Every water is colorless.' (Tsoulas 2008, p. 137)

Other determiners discussed by Tsoulas (2008) are acceptable with both mass nouns and count nouns. *Poli* ('much/many') and *lig(o/i)* ('little/few') can occur with both *nero* ('water') as in (5.4) and with *fitites* ('students') as in (5.5).

(5.4) Ipia poli / ligo nero.
drank.1SG much / a.little water
'I drank much (a lot of)/little water.' (Tsoulas 2008, p. 137)

(5.5) Poli / ligi fitites perasan tis exetasis.
many / few students passed the exams

[1]Special thanks to Vasileia Skrimpa and Eleni Gregoromichelaki for the original Greek data presented herein.

'Many/few students passed the exams.' (Tsoulas 2008, p. 137)

To my knowledge, outside of this description from Tsoulas (2008), little work has been done to demonstrate the extent to which these determiners are robust tests of the mass/count distinction, nor has there been an in-depth look at countability, testing a large variety of nouns in different environments, along the lines of those conducted in English (Allan 1980; Kiss et al. 2016). Because plural morphology can occur on mass nouns in Greek, and therefore cannot be used as a test for countability, the only two morphosyntactic environments that have been demonstrated to have sensitivity to the countability of nouns are direct counting and composition with *kathe* ('every'). Being morphologically equivalent to the number one in Greek, it is unclear if *enas* ('one') should be considered a separate test for countability along the lines of the indefinite determiner, *a*, in English. As for *meriki* ('some'), no data has been put forth to substantiate the claim that it is only felicitous with plural count nouns. Lastly, other than determiners like *poli* ('much/many') and *lig(o/i)* ('little/few'), which are able to combine with both count nouns and mass nouns, it seems there is no determiner that is felicitous only with mass nouns, as is the case for *much* in English. In summary, there are only two contexts that have been shown to uncover the mass/count distinction in Greek: direct counting and composition with *kathe* ('every').

5.1.1 Plural nouns in Greek

Though plural morphology is sometimes assumed to be one of the hallmark tests of the mass/count distinction, (Pelletier 1975; Allan 1980; Chierchia 1998a, 2010, 2015; Doetjes 2012), it proves to be less useful in Greek since mass nouns can take plural morphology without shifting to a kind or portion interpretation. As in English, plural morphology can occur on mass nouns when discussing kinds and portions.

(5.6) a. Dio elinikes bires vriskonte fetos anamesa
two.NOM Greek.NOM.PL beer.NOM.PL are.found this.year among
stis kaliteres tu kosmu...
at.THE.ACC best.ACC.PL the.GEN world.GEN.SG
'Two Greek beers are among the best ones in the world this year.'

b. Ipia dio bires prin ligo
drank.1SG two.ACC beer.ACC.PL before a.bit.ACC
'I drank two beers a while ago.' (Kouneli 2019, p. 239)

At the same time, however, Tsoulas (2008) argues that the examples in (5.1), (5.7)–(5.10) exemplify the phenomenon in Greek whereby mass nouns take plural morphology without shifting to kind or portion interpretation.

(5.7) Epesan nera sto kefali mu.
fell-3rd-pl water-PL.NEUT.NOM on-the head-NEUT-SG my
'Water fell on my head.' (Tsoulas 2008, p. 131)

(5.8) To patoma itan gemato nera.
The floor was full waters
'The floor was full of water.' (Tsoulas 2008, p. 133)

(5.9) Nera ke ladia sto dromo na fovase.
waters and oils on-the road SM be-afraid
'Be afraid of water and oil on the road.' (Tsoulas 2008, p. 133)

(5.10) Hithikan pola pota sto parti, to patoma kolage apo tis bires.
Were-spilled many drinks at-the party the floor stuck from the beers
'A lot of drinks were spilled at the party; the floor was sticky from the beer.'
(Tsoulas 2008, p. 136)

In support of this argument, Tsoulas (2008) shows that it is not possible to count the mass noun in this sort of context:

(5.11) *Dio nera trehun apo to tavani.
two water.PL run from the ceiling
'Two waters dripped from the ceiling' (Tsoulas 2008, p. 135)

Because *nera* ('waters') cannot be counted in (5.11), Tsoulas (2008) argues, *nera* ('waters') must be a mass noun.

It is crucial to note, however, that while plural mass nouns are possible, there are some restrictions on when they are felicitous. Alexiadou (2011) argues that Greek plural mass nouns are lexically restricted with respect to how freely certain nouns pluralize and which predicates they occur with. For example, *nero* ('water'), *ladi* ('oil'), *laspi* ('mud'), *ammos* ('sand'), *rizi* ('rice'), *chioni* ('snow') are argued to be better in plural form than *meli* ('honey'), *chymos* ('juice'), *kykloforia* ('traffic') (Alexiadou 2011, p. 36). It is also the case that Greek plural mass nouns are often used with *spray/load* predicates like 'fall', 'spray', 'drip', 'gather'. Though pluralization of mass nouns has been argued to be free by Kouneli (2019), the restrictions on plural mass nouns argued for by Alexiadou (2011) suggest that there is a relationship between the nouns themselves and the predicates they occur with. Further support for the restriction of plural mass nouns comes from Tsoulas (2008), who argues that plural mass nouns they cannot occur in generic statements like (5.12).

(5.12) *Ta nera vrazun stus 100 vathmous
The waters boil at 100 degrees
'Water boils at 100 degrees centigrade.' (Tsoulas 2008, p. 134)

Certain existential statements would also lead to infelicitous use of a plural mass noun, (5.13) argues, it would be strange if *'laspes'* ('mortars'/'muds') were used by a builder who is mixing mortar at a construction site:

(5.13) *I laspes eginan
The muds are-done
'The mortar is ready.' (Tsoulas 2008, p. 134)

Tsoulas (2008); Alexiadou (2011) and Kane et al. (2015) all argue that these plural mass nouns are accompanied by a 'much' inference, thereby explaining why (5.13) is infelicitous. However, Kouneli (2019) provides contexts in which larger volumes of substances—i.e. 'much'—would not be described with plural mass nouns while certain smaller, yet spread/scattered amounts of a substances would freely allow the use of plural mass nouns. One of the key examples from Kouneli (2019) is a pan is full of cooked rice, which would only be felicitously described with the singular mass noun, (5.14-a). This stands in comparison to the same pan containing only a handful of grains of rice scattered across its surface, for instance, after a meal has been eaten, which can felicitously be described by either the singular or plural, (5.14-b).

(5.14) a. I katsarola exi rizi.
the.NOM pan.NOM.SG has.3SG rice.ACC.SG
'The pan has rice.'

b. I katsarola exi rizia.
the.NOM pan.NOM.SG has.3SG rice.ACC.PL
'The pan has rice all over its surface.' (Kouneli 2019, p. 241)

Similarly a tub filled with water in preparation for a bath can only be described as with the singular *nero* ('water'), (5.15-a), while that same tub that only has a bit of water in the bottom and on the upper edge can be described as full of *nero* ('water') or *nera* ('waters') as in (5.15-b).

(5.15) a. I baniera ine gemati nero.
the.NOM bathtub.NOM.SG is.3SG full.NOM.SG water.ACC.SG
'The bathtub is full of water.'

b. I baniera ine gemati nera.
the.NOM bathtub.NOM.SG is.3SG full.NOM.SG water.ACC.PL
'There is water all over the bathtub's surface.' (Kouneli 2019, p. 241)

Kouneli (2019) argues that these examples show that the interpretation of the plural mass noun is "spread over a surface in a disorderly way", rather than "a great amount of".

In addition to these instances of plural mass nouns being used to discuss, spills, drips, and scattered amounts, it is also the case that, as in (5.16), very large amounts can be referred to with a plural mass noun in Greek (Kouneli, p.c.). Such uses of *nera* ('waters') are abundant in the Corpus of Modern Greek, for example, 35 instances were found out of 150 randomly selected sentences containing *nera* ('waters') in the Corpus of Modern Greek.

(5.16) Tzóni efthýmise anakalóntas sti mnímі tou to pálai poté kinitó tou kai tin olympiakón epidóseon voutiá pou ékane sta neá tou Saronikoú.
'Johnny was cheered up in recalling his dive into the waters of the Saronic Gulf.'
Erbach (2019)

It is unknown, however, how many substance nouns are used in such contexts.

The fact that Greek uses plural morphology on mass nouns without coercing a kind or portion reading makes it unlike number marking languages like English. There are a number of other languages, however, in which plural morphology occurs on mass nouns without coercion: Persian (Sharifian and Lotfi 2003), Hebrew (Doron and Müller 2013), Halkomelem Salish (Wiltschko 2008), Ojibwe (Mathieu 2012; Wiltschko 2012), and Blackfoot (Wiltschko 2012).

5.1.2 Bare nouns in Greek

Another characteristic property of the mass/count distinction in English is that singular count nouns cannot occur bare but mass nouns and plural count nouns can (Chierchia 1998a). Greek is somewhat different from English in this respect. Greek singular count nouns can occur bare in object position with specific verb classes (Sioupi 2001, 2002). According to Lazaridou-Chatzigoga and Alexandropoulou (2013), the classes that accept bare singular count nouns are consumption verbs (5.17), transfer verbs (5.18), ownership verbs (5.19), intensional verbs (5.20), usage verbs (5.21), light verbs (5.22), institutionalized activities (5.23), creation verbs (5.24), and existential constructions (5.25).

(5.17) Kapnizun tsigharo.
are.smoking/smoke.3PL cigarette

'They are smoking/smoke a cigarette.'

(Lazaridou-Chatzigoga and Alexandropoulou 2013, p. 238)

(5.18) Ihe aghorasi isitirio kero prin.
had.3SG bought.3SG ticket time ago
'S/he had bought a ticket a long time ago.'

(Lazaridou-Chatzigoga and Alexandropoulou 2013, p. 238)

(5.19) O vuleftis ihe aftokinito, ala itan halasmeno.
the MP had car but was.3SG broken
'The MP had a car, but it was broken.'

(Lazaridou-Chatzigoga and Alexandropoulou 2013, p. 238)

(5.20) Mu ipe oti arketo kero epsahne spiti stin periohi.
me.GEN.CL said that quite.some time was.searching house in.the area
'S/he told me that s/he has been looking for a house this area for long.'

(Lazaridou-Chatzigoga and Alexandropoulou 2013, p. 238)

(5.21) O dhrastis bike forodas kranos.
the perpetrator entered.3SG wearing helmet
'The perpetrator entered wearing a helmet.'

(Lazaridou-Chatzigoga and Alexandropoulou 2013, p. 238)

(5.22) Kanun podhilato stin Oxford Street.
Do.3PL bicycle in.the Oxford Street
'They cycle in Oxford Street.'

(Lazaridou-Chatzigoga and Alexandropoulou 2013, p. 239)

(5.23) O alos dhyavazi efimeridha kathistos.
the other is.reading/reads-3SG newspaper seated
'The other one is reading a newspaper while seating.'

(Lazaridou-Chatzigoga and Alexandropoulou 2013, p. 239)

(5.24) Epita eghrapsa ghrama ston Ai Vasili.
then wrote.1SG letter to.the Santa Claus
'Then I wrote a letter to Santa Claus.'

(Lazaridou-Chatzigoga and Alexandropoulou 2013, p. 239)

(5.25) Ehi ghamo sto dhiplano horio.
has wedding in.the next village
'There is a wedding in the next village.'

(Lazaridou-Chatzigoga and Alexandropoulou 2013, p. 239)

In being able to use bare singular count nouns as arguments, Greek is more like classifier languages—e.g. Mandarin, Japanese—than other number marking languages—e.g. English. However, The use of bare singular nouns is much more restricted in Greek than in classifier languages. This nevertheless exhibits the fact that, with respect to the distribution of bare singular count nouns, in addition to the distribution of plural morphology, and the number of morphosyntactic environments that are sensitive to the mass/count distinction, Greek does not strongly align with languages like English, though both are commonly assumed to have a mass/count distinction.

5.1.3 Object mass nouns in Greek

Though there has been little work investigating the robustness of the mass/count distinction in Greek, there has been some work on whether or not Greek has object mass nouns.

According to Tsoulas (2008), it seems that there are no object mass nouns in Greek. Supporting this claim is the fact that the Greek counterparts to several canonical English mass nouns are count:

(5.26) a. *epiplo* ('piece of furniture'), *epipla* ('pieces of furniture')
b. *maheropiruno* ('piece of cutlery'), *maheropiruna* ('pieces of cutlery')
c. *asimiko* ('piece of silverware'), *asimika* ('piece of silverware')
(Tsoulas 2008, p. 138)

Though it is unclear exactly how many nouns Tsoulas (2008) considered, this claim has nevertheless been cited and considered with respect to the formulation of semantic analyses of the mass/count distinction (Chierchia 2010, 2015).

Alexiadou (2015) shows there is reason to believe Greek does, in fact, have object mass nouns. *Epiplosi* ('furniture'), for example, can refer to one or more objects without plural morphology, (5.27), and it can felicitously be modified by stubbornly distributive predicates, (5.28), thereby showing it denotes objects (Schwarzschild 2011; Rothstein 2010).

(5.27) Agorasa kenuria epiplosi ja to grafio mu
bought-1SG new furniture for DEF office my
'I bought new furniture for my office.' (Alexiadou 2015, p. 14)

(5.28) I epiplosi sto domatio ine strogili.
the furniture in room is round

'The furniture in the room is round.' (Alexiadou 2015, p. 15)

Despite the fact that plural morphology occurs on mass nouns, as shown at the beginning of this section, Alexiadou (2015) assumes it can still be used as a test for the mass/count distinction in Greek, meaning the fact that *ruhismos* ('clothing') cannot take plural morphology, (5.29), is evidence that it is an object mass noun.

(5.29) *ruhismi
*clothings (Alexiadou 2015, p. 15)

With these examples as evidence, Alexiadou (2015) argues that Greek has object mass nouns.

Alexiadou (2015) also points out several nouns that refer to objects and only have a plural form in Greek.

(5.30)

*resto	resta
piece.of.change	change.PL
'piece of change'	'change'
*bagazi	bagazia
piece.of.luggage	luggage.PL
'piece of luggage'	'luggage'
?maheropiruno	maheropiruna
piece.of.cutlery	cutlery.PL
'piece of cutlery'	'cutlery'

(Alexiadou 2015, p. 20)

Like object mass nouns, these plural nouns cannot directly compose with numericals:

(5.31) *dos mu tria resta
give me three change.PL
'*Give me three change.' (Alexiadou 2015, p. 21)

Alexiadou (2015) does not explicitly refer to these nouns as object mass or pluralia tantum, nor does she further describe their grammatical behavior with respect to the mass/count distinction in Greek. Alexiadou (2015) only explicitly categorizes *epiplosi* ('furniture') and *ruhismos* ('clothing') given they do not pattern like count nouns in two tests: as arguments of the definite determiner, and acceptability with plural morphology. This argument makes Greek resemble other number marking languages more so than under the analysis of Tsoulas (2008) and Chierchia (2015).

5.2 Previous analyses

5.2.1 Predicting a lack of object mass nouns in Greek

While Tsoulas (2008) focuses on plural mass nouns in Greek, his discussion of the mass/count distinction in Greek includes the argument that Greek does not seem to have object mass nouns. His analysis of the Greek nominal system calls for an analysis of object mass nouns like that in Chierchia (2010, 2015), in which they arise due to lexical choice in languages, like English, that do not allow mass nouns to be plural. While Chierchia (2015) argues for a different analysis of the Greek nominal system, his is similar to that of Tsoulas (2008) in that it predicts that object mass nouns should not arise in Greek.

5.2.2 Intersective plurals: Tsoulas (2008)

Tsoulas (2008) focuses on plural mass nouns in Greek that are accompanied by an inference that conveys a meaning like "there is more of the stuff"—a characteristic that is typically not seen in number marking languages (Chierchia 2010, 2015). His discussion of the mass/count distinction in Greek serves to illustrate the fact that these plural mass nouns are not countable and therefore mass on the one hand, but pattern like plural count nouns with respect to determiners like *poli* ('much/many]) on the other hand. He also argues that Greek has no object mass nouns because the collective aggregate nouns that typically comprise this category all have singular and plural count interpretations (5.26), notwithstanding frequency.

Tsoulas (2008) follows Chierchia (1998a) in assuming that singular count nouns denote atoms, plural count nouns exclusively denote sums of atoms, and mass nouns denote an atomic join semilattice. Tsoulas (2008) builds on Chierchia (1998a) by including two features borrowed from Harbour (2007). The two features borrowed by Tsoulas (2008) are [+singular] and [+augmented], (5.32), where nouns that strictly denote atoms are marked [+singular] and nouns that have the property of divisibility are [+augmented].

(5.32) a. $[+\text{singular}] = \text{atom}(x)$
b. $[+\text{augmented}] = \lambda P \exists y[P(x) \wedge P(y) \wedge y \sqsubset x]$ (Harbour 2007, p. 63)

Tsoulas (2008) proposes that the root of every noun is number neutral [± singular] and that it is a Num head that dictates whether nouns are morphologically singular [+singular] or plural [-singular]. Singular count nouns are [-augmented,+singular], denoting only atoms. Plural count nouns are [+augmented,-singular], which, by definition, means they

are exclusively sum denoting because atoms relative to a predicate have no proper parts that are also atoms relative to that predicate. Being marked [-singular] corresponds to both plural morphology on nouns and, in Greek, Tsoulas (2008) argues, intersective adjectival modification, (5.33).

(5.33) Waters = water(x) ∧ plural(x) (or nonsingular) (Tsoulas 2008, p. 143)
whatever semantic operation is chosen given the definition

Tsoulas (2008) therefore argues that Greek plural morphology is fundamentally different from that in English, which, on Chierchia's (1998a) account, is strictly tied to number and corresponds to the closure of atoms under sum with the atoms removed. With these assumptions, plural morphology is predicted to freely occur on mass nouns in Greek, which are formally marked [+augmented], unlike plural morphology tied strictly to semantic pluralization, which would be redundant on a mass noun that already denotes an atomic semi-lattice. Tsoulas (2008) proposes the constraint on plural mass nouns is a plurality/quantity implicature that arises from a reduplication of plurality (one notion of plurality from the lattice structure in [+augmented], and another notion of plurality from the morphology in [-singular]). When a mass noun is [+singular], there is indeed conflict between this and [+augmented]. The resolution of this conflict is the type-shifting of the noun to a kind-denoting predicate. This approach to the treatment of singular mass nouns is similar to that in Chierchia (2010), where mass nouns are also type-shifted because of restrictions on number marking.

5.2.2.1 Singleton properties: Chierchia (2010)

Chierchia (2010) has a different approach to the mass/count distinction than that in 1998a. The domain of discourse for entities of type e is still an atomic semilattice closed under a join operation, ⊔, though Chierchia (2010) now defines 'relative atoms', with respect to a predicate, as individuals in the denotation of the the predicate that only have themselves as parts (5.34).

(5.34) If P is of type ⟨e⟩, AT(P)={x∈P: ∀y∈P[y≤x→x=y]}

The most significant departure from Chierchia (1998a) is the use of supervaluationist semantics to define vague predicates. While count atoms are "stable", denoting some minimal entities that are atomic across all precisifications, mass individuals are "unstable", denoting entities that are minimal on some precisifications, but not all. In other words, unstable individuals can fall on either side of the atom/sum divide in respect to different

precisifications. The idea behind this definition of atoms with respect to precisification is contextual variation with respect to what is sufficient for using the noun. For example, part of a rice molecule is assumed to never be sufficient for using the noun *rice*, though a bowl of rice is assumed to always count as *rice*, and there are amounts of rice in between these that might or might not count as *rice* in a particular context. Chierchia (2010) provides the following argument:

> we might consider a grain of rice, rice [allergy testing, cereal cultivation, HF]. But, then that applies to half grains as well. And to quarters of grains. In certain cases, we may regard rice flour as rice (as when we say there is rice in this cake). The point is that there is no systematic basis for deciding which rice amounts qualify as rice atoms (Chierchia 2010, pp. 117-8)

This variable applicability of *rice* characterizes its instability, which allows for the following characterization of count nouns and mass nouns in a model M, relative to a context c, and an assignment g: if a noun is count, then the stable atoms it denotes are atoms of the domain of individuals, while if a noun is mass, then it does not denote stable atoms at all.

(5.35) For any M, c, and g,
if N is count $[\![\mathbf{AT}(\mathrm{N})]\!]_{\mathrm{M,g,c}} \subseteq \mathrm{AT_c(U)}$ = any count N has stable atoms
if N is mass $[\![\mathbf{AT}(\mathrm{N})]\!]_{\mathrm{M,g,c}} = \varnothing$ = no mass N has stable atoms
(Chierchia 2010, p. 123)

In addition to these assumptions about what makes a noun mass versus count, Chierchia (2010) defines what makes a noun singular and plural. Singular nouns are those that have no proper parts of which the same singular noun is true, and in this sense singular nouns correspond to 'relative' atomicity. Plural nouns are those that denote the closure under sum of atoms denoted by the corresponding singular noun. This definition of singular nouns, however, does not apply to mass nouns which, until this point, have been assumed to denote the closure under sum of unstable atoms. In order to rectify this incompatibility, Chierchia (2010) proposes that number marking languages like English encode all mass nouns as singleton properties, that is, the supremum of the semi-lattice they are otherwise assumed to denote, (5.36).

(5.36) $\mathrm{water}=\lambda x[x=w_{MAX,w}]=\{w_{MAX,w}\}$,
where $w_{MAX,w}$ is the sum of all the water there is in w.(Chierchia 2010, p. 136)

This singleton property fulfills the definition of stable atomicity required by singular nouns, thereby predicting that mass nouns are encoded as singular nouns rather than plural nouns. Along with lexical choice, this means of encoding nouns as singleton properties, Chierchia (2010) argues, is what gives rise to object mass nouns in English. *Furniture* and *footwear* for example, despite denoting stably atomic entities, are encoded as singleton properties as a matter of lexical choice, and therefore grammatically behave like substance denoting nouns.

Returning to Tsoulas's (2008) analysis of the Greek nominal system, while the [+singular] feature in Greek requires singular nouns to denote atoms much like Chierchia's (2010) definition of singular nouns in English, Greek is different in that mass nouns are type-shifted to a kind denotation rather than a singleton property as in English. Tsoulas (2008) considers this difference and indication that Greek number marking is only indirectly related to number. Presumably, it is this difference in type shifting that, under Tsoulas's (2008) analysis of Greek, results in the prediction that there should be no object mass nouns in Greek, which is born out in his analysis of the available data.

5.2.3 Weak vs. strong number marking: Chierchia (2015)

Chierchia (2015) takes a different approach to formalizing the analysis in Chierchia (2010), and gives a different analysis of Greek than that of Tsoulas (2008). Rather than grounding notions of atomic '(in)stability' in supervaluationist semantics as in 2010, Chierchia (2015) grounds these notions in modal semantics. Instead of denoting some entities that are atoms at every precisification, the stable atoms that count nouns denote are defined as being atoms in every accessible world (5.37).

(5.37) $\mathrm{AT(P)} = \lambda \mathrm{w} \lambda \mathrm{x}[\mathrm{P_w(x)} \wedge \forall \mathrm{w'} \epsilon \mathrm{K_w} \forall \mathrm{z}[\mathrm{P_{w'}(z)} \wedge \mathrm{z} \leq \mathrm{x} \rightarrow \mathrm{z} = \mathrm{x}]]$ (Chierchia 2015, p. 161)

Unstable atoms are those that might be a plurality in an accessible world, (5.38).

(5.38) $\mathrm{MASS(P)} = \forall w \forall x[P_w(x) \wedge \forall z[P_w(z) \wedge z \leq x \rightarrow z = x] \rightarrow \Box \forall y[P(y) \wedge y \leq x \rightarrow y = x]]$ (Chierchia 2015, p. 160)

Chierchia (2015) maintains that atomicity is encoded directly in number marking in languages like English: singular nouns must be atomic and plural nouns are the closure under sum of atoms (5.39).

(5.39) a. $\mathrm{PL(P)}=\mathrm{P}$ if $^{*}\mathrm{AT(P)}=\mathrm{P}$

b. SG(P)=P if AT(P)=P (Chierchia 2015, p. 164)

Just as in Chierchia (2010), the new analysis based in modal semantics assumes that, because of the requirement that singular nouns denote atoms in (5.39), mass nouns are encoded as "singleton properties true of maximal plural individuals, which can be regarded as stably atomic" (Chierchia 2015, p. 164). This approach results in the same two predictions that follow from Chierchia's (2010) analysis. The first prediction is that object mass nouns arise as a matter of lexical choice, that is, when nouns that denote stable atoms copy those that denote unstable atoms in being encoded as a singleton property. The second prediction is the inability to have plural mass nouns, because the closure under sum of a singleton is semantically vacuous and therefore its basic meaning cannot be changed. This is a desirable prediction for Chierchia (2015) who assumes that pluralization and counting are the primary tests for the mass/count distinction. In addition to these, he lists the characteristics of measure phrases and object mass nouns as two phenomena that must be accounted for as part of the mass/count distinction.

Greek, however, is assumed to be unlike English in that it has weaker definitions of number marking that are not rooted in the modal definition of atomicity. Instead, plural nouns are the closure under sum of the denotation of the predicate, while singular nouns are only necessarily atoms in actual world (5.40).

(5.40) a. $PL(P) = P$ if $^*P = P$

b. $SG(P) = P$ if $\forall w \forall x[P_w(x) \rightarrow \forall z[P_w(z) \wedge z \leq x \rightarrow z{=}x]]$(Chierchia 2015, p. 164)

Unlike English, where mass nouns denote singleton properties, mass nouns in Greek, therefore, denote the (unstable) minimal quantities of entities denoted by the noun, which can straightforwardly be pluralized just like a mass noun. *Rizi* ('rice') refers to unstable atoms and *rizia* ('rices') refers to the closure under sum of these unstable atoms. This account predicts that singular mass nouns in Greek are not cumulative, because they denote unstable atoms rather than sums thereof or a trivially cumulative singleton property. This analysis of Greek also predicts it should not occur that, via lexical choice, stably atomic nouns become singleton properties and thereby become object mass nouns. This choice should not occur because stable atomicity is not encoded in the meaning of singular nouns, and nouns that denote unstable atoms are free to do just that—i.e. they are not forced to denote a singleton property. Chierchia (2015) does not explicitly state whether or not Greek might still have or use a means of encoding nouns as singleton properties despite the fact that it is not needed for singular nouns that denote unstable atoms. Without such encoding, it is unclear how this analysis would account for object

mass nouns in Greek. In general, Chierchia's (2015) account of number marking in Greek and English ties the existence of both plural mass nouns and object mass nouns in a particular language to the particular type of number marking that language has, weak or strong.

5.2.4 Lexical plurals: Alexiadou (2011, 2015) and Kouneli (2019)

Alexiadou (2011) and Kouneli (2019) both argue for a lexical approach to the analysis of plural mass nouns in Greek, which is based on the analysis of lexical plurals by Acquaviva (2008). While both Alexiadou (2011) and Kouneli (2019) assume a lexical inference is in the literal meaning of sentences, their analyses differ in that Alexiadou (2011) argues the inference is equivalent to 'much' and Kouneli (2019) argues the inference is equivalent to 'spread/scattered'. Despite these differences, both Alexiadou (2011) and Kouneli (2019) assume, like Acquaviva (2008), that there are two distinct forms of plural morphology.

The two types of plurals argued for by Acquaviva (2008) are grammatical plurals and lexical plurals. Grammatical plurals are those that correspond to semantic pluralization, which has been widely assumed since Link (1983) to be the closure of individuals under sum. Grammatical plural morphology, therefore corresponds to a semantic operation on the singular noun that results in reference to sums of individuals (and possibly also the individuals themselves if one is arguing for an inclusive analysis of plurals rather than an exclusive analysis). Lexical plurals are those that result from plural morphology combining with a root resulting in plurality being encoded into the meaning of the noun upon lexicalization. Crucially, the contribution of plurality in lexical plurals does not correspond to "many an x" as Acquaviva (2008) assumes is the case for grammatical plurals. The class of lexical plurals, argued for by Acquaviva (2008) contains a variety of meanings that are more nuanced than the grammatical counterpart. *Scissors*, for example, is assumed to be a lexical plural in which plural morphology makes reference to the component parts. For *brethren*, the irregular plural form of *brother*, plural morphology coincides with a meaning meaning more like *confrères* in French than *brothers* in English.

Alexiadou (2011) and Kouneli (2019) argue that the difference between Greek and English is that Greek has lexical plurals that make reference to 'a lot of' or 'spread/scattered' substances. In this way, they do not assume that Greek number marking as a whole is different from that in English as is done by Tsoulas (2008) and Chierchia (2015). with this analysis Alexiadou (2011) and Kouneli (2019) do not commit to any relationship between plural mass nouns and object mass nouns in Greek, thereby allowing both to coexist.

With respect to object mass nouns in Greek, Alexiadou (2015) provides a morphosyntactic analysis rooted in Distributional Morphology. Alexiadou (2015) follows Harley (2005) and Borer (2013) in assuming that roots can be categorized into ontological types—e.g. things/entities and states—and affixes carry semantic content and categorize words—e.g. nominalize roots. In this analysis, category defining heads form words—e.g. n (noun) or v (verb)—in two ways: (i) they combine directly with a root—e.g. root nominalization—or (ii) they occur with a stem—e.g. deverbal nominalization (5.41).

(5.41) $[_{nP}$ m $[_{v}$ iz $[_{\surd}$ ruh]]] *rohismos* ('clothing') (Alexiadou 2015, p. 19)

Under the analysis of Alexiadou (2015), object mass nouns are interpreted as a bundled aggregate, e.g. (5.41), or as a collectivity of entities, neither of which can be individuated. Individuation is assumed to be a morphosyntactic process that occurs, for example, with grammatical pluralization. This analysis accounts for the fact that *rohismos* ('clothing') has been reported to have no plural form, neither grammatical, because it cannot be individuated, nor lexical, presumably because it simply has no lexical plural form under an analysis like that of Alexiadou (2011) or Kouneli (2019).

5.2.5 A scalar implicature-based account of plurals: Kane et al. (2015)

Kane et al. (2015) do not discuss whether or not Greek has object mass nouns as the focus of their analysis is providing a proof of concept for a scalar implicature based approach to the meaning of plural mass nouns in Greek. With respect to the mass/count distinction, Kane et al. (2015) assume that singular count nouns denote atomic individuals, plural count nouns denote atoms and sums thereof, and mass nouns are inherently semantically plural, denoting atoms and sums thereof. Following Chierchia (2010), they assume that mass noun atoms are unstable thereby distinguishing them from plural count nouns. Kane et al. (2015) assume that plural morphology corresponds to the closure of individuals under sum, explaining the correspondence of plural count nouns to singular count nouns. However, because mass nouns are inherently semantically plural, the closure under sum associated with morphological pluralization is semantically redundant on mass nouns. At the same time, however, pluralization triggers a scalar implicature on both count nouns and mass nouns, where the inference associated with count nouns is 'two or more' and the inference associated with mass nouns is 'much'.

Kane et al. (2015) follow Spector's (2007) approach to scalar implicatures, though they assume any other approach is compatible as well. The reason for providing a scalar implicature based approach, Kane et al. (2015) argue, is that it can cover more data than the lexical approach—e.g. Alexiadou (2011)—which encodes a much inference directly in

the noun. The lexical approach is insufficient in that it cannot account for the fact that plural mass nouns in negative statements, conditionals, and questions are not equivalent to 'much N'. While, *nera* ('waters') in (5.42), is argued to be equivalent to *much water* by Alexiadou (2011), this equivalency does not hold in downward entailing environments such as the negative statement in (5.43), where it is not the case that John spilled any water at all.

(5.42) O Yanis ehise nera.
'John spilled waters.'
$\rightsquigarrow$ *John spilled much water.* (Kane et al. 2015, p. 328)

(5.43) O Yanis den ehise nera.
'John didn't spill waters'
$\not\rightsquigarrow$ *John didn't spill much water.*
$\rightsquigarrow$ *John didn't spill any water.* (Kane et al. 2015, p. 328)

If *nera* ('waters') expressed 'much water' in (5.43), Kane et al. (2015) argue, then it should be able to be the case that John spilled a little bit of water, which would be true if the utterance were actually "John didn't spill much water".

Kane et al. (2015) demonstrate that contexts in which an inference is present in plural mass nouns parallel those in which a 'two or more' inference is present in plural count nouns, that is, both are present in upward entailing environments and disappear in downward entailing environments. (5.44) shows an exclusive plural interpretation of *giraffes*, meaning that John saw two or more giraffes.

(5.44) John saw giraffes.
$\rightsquigarrow$ *John saw two or more giraffes.* exclusive reading (Kane et al. 2015, p. 326)

Giraffes is interpreted inclusively in (5.45), however, meaning that John cannot have seen even one giraffe.

(5.45) John didn't see giraffes.
$\not\rightsquigarrow$ *John didn't see two or more giraffes.*
$\rightsquigarrow$ *John didn't see one or more giraffes.* inclusive reading
(Kane et al. 2015, p. 326)

Because the 'much' inference of plural mass nouns patterns with the exclusive inference associated with plural count nouns, Kane et al. (2015) analyze the former as arising via the same mechanism as the latter, namely scalar implicature based on exhaustification of alternatives, (5.46), where the competitors are {PL, SG}; {SG_{COUNT}, two or more }; {SG_{MASS}, much }. Exhaustification negates and excludes alternative utterances derived from competitor sets.

(5.46) $[\![\text{EXH}p]\!]^w = [\![p]\!]^w \wedge \forall q \in \text{EXCL}(p, Alt(p))[\neg[\![p]\!]]^w$
$\text{EXCL}(p, X) = \{q \in X : p \not\subseteq q \wedge \neg\exists r[(p \wedge \neg q) \subseteq r]\}$ (Kane et al. 2015, p. 325)

In the analysis of Kane et al. (2015), interpreting the plural mass noun in (5.42) requires assuming that the plural is equivalent to the singular, which is paraphrased in English as the argument of the Alt function in (5.47). Exhaustification of the singular has the interpretation in (5.48).

(5.47) $\text{Alt}(\text{John spilled water}) = \left\{ \begin{array}{l} \text{John spilled water} \\ \text{John spilled much water} \end{array} \right\}$
(Kane et al. 2015, p. 328)

(5.48) $[\![\text{EXH}]\!]^w(\text{John spilled water}) = [\![\text{John spilled water}]\!]^w \wedge$
$\neg[\![\text{John spilled much water}]\!]^w$
$= [\![\text{John spilled little waters}]\!]^w$
(Kane et al. 2015, p. 328)

A 'much' inference results when the plural sentence is doubly exhaustified, (5.49).

(5.49) $[\![\text{EXH}]\!]^w([\![\text{EXH}]\!]^w(\text{John spilled waters})) =$
$[\![\text{John spilled waters}]\!]^w \wedge \neg[\![\text{John spilled little water}]\!]^w =$
$[\![\text{John spilled much waters}]\!]^w$ (Kane et al. 2015, p. 328)

With the scalar implicature based analysis of plural mass nouns in Greek, Kane et al. (2015) are able to account for more data pertaining to plural nouns than the lexical approach accounts for. Though object mass nouns are not addressed by Kane et al. (2015), presumably they could adopt the analysis of object mass nouns from Chierchia (2010) in the same way that they adopt some of his other assumptions.

5.2.6 Measure based plurals

In Erbach (2019), I proposed that a measure based analysis of plural mass nouns in Greek, built on the analysis of nominal semantics in Filip and Sutton (2017) and the analysis of plural count nouns in Grimm (2013), can be used to account for all of the relevant properties of plural mass nouns in Greek. This account does not explicitly address object mass nouns in Greek, though being based on the nominal semantics in Filip and Sutton (2017), object mass nouns are free to occur in Greek as this account bases their existence on non-disjointness of the counting base of the noun, similar to Landman (2011, 2016).

5.2.6.1 Grimm (2013)

Grimm (2013) argues against the scalar implicature approach to plurals and for a Question Under Discussion (QUD) based approach to the analysis of plural nouns, building on the analysis of nouns in Krifka (1995). To support his argument against the scalar implicature approach, Grimm (2013) shows that Negative Polarity Item (NPI) licensing environments and others can get inclusive plural interpretations despite the fact that they are not downward entailing, which, under the scalar implicature approach, should mean an inclusive plural interpretation is impossible. As an alternative, Grimm (2013) argues that the immediate Question Under Discussion (QUD) is what drives the interpretation of plural nouns: if the immediate QUD is concerned with a number of concrete entities greater than or equal to two, then the reading is exclusive; if the QUD is concerned with the type of thing named, then the plural gets a generic, inclusive interpretation. Grimm's (2013) analysis builds on Krifka (1995) with respect to the structure of nouns, and it builds on Roberts (1996) with respect to the structure of discourse.

Grimm (2013) gives several examples that show inclusive and exclusive readings of plural nouns where they are not predicted to occur under the scalar implicature based approach. For example, the inclusive interpretation is sometimes available in environments that are not downward entailing and NPI-licensing environments, which suggests that inclusive interpretations are strictly a matter of scalar reasoning. In both (5.50) and (5.51), the plurals nouns *residents* and *houses* must have inclusive interpretation, even though they are not in downward entailing environments, because in both cases a single individual might provided what is needed—i.e. information to find the thief or directions. In both cases, exclusive reference to sums cannot be required.

(5.50) Sherlock Holmes should question local residents to find the thief.(Grimm 2013)

(5.51) I am looking for houses to try to find someone to give us directions.

Similar to the exceptions in downward entailing environments, NPIs, do not strictly align with inclusive interpretation.

(5.52) a. I am surprised that anything was there. [NPI OK]
b. I am surprised that boxes were in the office. [exclusive plural only]

(5.53) a. #Both students who saw *anybody* reported to the police. [NPI not OK]
b. Both students who saw *spies* reported to the police. [inclusive plural]
(Grimm 2013)

If inclusive plurals are assumed to strictly align with NPIs, then the data above could not be true. While inclusive readings do not strictly align with downward entailing environments and NPI-licensing environments, Grimm (2013) argues that inclusive readings of plurals can be said to align with generic interpretations. Grimm (2013) supports the assumption that inclusive readings align with generic readings with experimental evidence that shows participants prefer inclusive interpretations more strongly in generic constructions and that they prefer exclusive interpretations in existential constructions.

Grimm (2013) builds his formal analysis of nouns on Krifka (1995), and he assumes a structure of discourse like that argued for by Roberts (1996). Like Krifka (1995), Grimm (2013) assumes that nouns make reference to concepts, objects, and number. Concepts are referenced via the realization relation, R_i, and objects are referenced via the OU_i function. The variable i is type s and it ranges over possible worlds:

(5.54) $$\lambda y.\lambda i.\lambda n.\lambda x.[\mathrm{R}_i(x,y) \wedge \mathrm{OU}_i(y)(x) \;=\; n]$$
(Grimm 2013)

In this analysis, plural nouns that refer to instances of a concept versus those that refer to a quantified individual are differentiated between when n takes a specific number or not. When n is under existential quantification rather than being specified, the noun references an instance of a concept and the interpretation is inclusive. When n is ≥ 2, the noun references a quantified individual and the interpretation is exclusive.

(5.55a) $$[\![\text{dogs}]\!] \;\coloneqq\; \lambda i.\lambda x.[\mathrm{R}_i(x, DOG) \wedge \mathrm{OU}_i(DOG)(x) \;\geq\; 2]$$

(5.55b) $$[\![\text{dogs}]\!] \;\coloneqq\; \lambda i.\lambda x.\exists n[\mathrm{R}_i(x, DOG) \wedge \mathrm{OU}_i(DOG)(x) \;=\; n]$$
(Grimm 2013)

In a given sentence, whether a noun like *dogs* gets an exclusive or inclusive interpretation is dependent on the QUD, building on the theory of discourse in Roberts (1996).

Both existential and generic interpretations are available under this sort of analysis for sentences like *Ed saw dogs*, conditionals, polar interrogatives, and sentences under negation. Answers to the QUD are assumed to be strongly exhaustive, following the analysis of the meaning of a questions by Groenendijk and Stokhof (1984). The meaning of a question, $?p$, is given by a partition theory of questions, so the positive statement in (5.56) corresponds to the QUDs in (a.) and (b.). When reference to particular entities is determined, the Quantitative QUD is assumed.

(5.56) Ed saw dogs.

a. Did Ed see dogs? (Existential QUD)
$?(\lambda i \exists x \exists n[\text{Ed see } x \textit{ in } i \wedge R_i(x, DOG) \wedge OU_i(DOG)(x) = n])$

b. Did Ed see dogs? (Quantitative QUD)
$?(\lambda i \exists x[\text{Ed see } x \textit{ in } i \wedge R_i(x, DOG) \wedge OU_i(DOG)(x) \geq 2])$ (Grimm 2013)

The Existential QUD is assumed for negative statements, because it amounts to denying the existence of all entities designated by the noun.

(5.57) Ed didn't see dogs.

a. *Existential QUD*: Did Ed see any dogs?

b. ?*Quantitative QUD*: Did Ed see a plurality of dogs? (Grimm 2013)

While Grimm's (2013) analysis of plural nouns captures the readings of plural count nouns, it is not clear exactly how the inferences associated with plural mass nouns in Greek would be accommodated in this system. For example, Krifka (1995) assumes that the interpretation of mass nouns cannot be applied to numbers, because it is not relational. Because Grimm (2013) follows Krifka (1995), it is unclear how plural mass nouns in Greek would be integrated into this analysis of nouns.

5.2.6.2 Counting, measuring, and quantization

The analysis of Greek number marking proposed in Erbach (2019) combines the interpretation of plurality in Grimm (2013) with the lexical structure of nouns from Filip and Sutton (2017). As observed in Chapter 3, Sutton and Filip (2016b,c), inspired by Landman (2011), analyze the lexical entries of nouns as ordered pairs of the kind $\langle$**extension, c_base**$_P\rangle$, where the first projection of the pair is a predicate for the extension of the noun and the second projection contains a predicate for the counting base of the noun. Filip and Sutton (2017) add a third projection, **preconditions**, which contains preconditions for composition, for example the restriction argued for by Krifka (1989)

that requires non-quantized predicates in extensive measure phrases. The preconditions are assumed to be the null proposition for nouns like *fences*, (5.59d). As in Sutton and Filip (2016b,c), the lexical entries of substance and object nouns are semantically distinguished, by Filip and Sutton (2017), with an individuation function, $\mathbf{IND}_{\langle\langle e,t\rangle,\langle e,t\rangle\rangle}$, which identifies individuals that can count as one. The function $c_{\langle\langle e,t\rangle,\langle e,t\rangle\rangle}$ identifies individuals that are to counted according to a certain schema. The *null counting schema*, c_0, denotes a set of all, possibly non-disjoint individuals, while a *specific counting schema*, c_i, denotes a maximally disjoint subset of individuated entities.

Numericals are assumed to denote numerals, which require modification before they can directly combine with nouns. This modifying function *MOD* contains the precondition that the noun to be counted has a quantized counting base. A predicate is quantized iff it holds of something but not of that thing's proper parts (Krifka 1989, 1995).

(5.58) QUANTIZED P : $\forall P[\mathrm{QUA}(P) \leftrightarrow \forall x \forall y[P(x) \wedge P(y) \rightarrow \neg(x \sqsubset y)]]$

(Krifka 1989, p. 78)

Both *fence* and *cat* have disjoint counting bases, which are specified by the specific counting schema, c_i, so counting is possible as represented in (5.59).

(5.59a) $[\![\text{three}]\!]^{c_i} = 3$

(5.59b) $\mathrm{MOD} = \lambda n.\lambda P.\lambda x.\langle \pi_1(P(x)),\ \mu_{card}(x, \pi_2(P(x)) = n,\ \mathrm{QUA}(\pi_2(P(x)))\rangle$

(5.59c) $\mathrm{MOD}([\![\text{three}]\!]^{c_i}) = \lambda P.\lambda x.\langle \pi_1(P(x)), \mu_{card}(x, \pi_2(P(x)) = 3, \mathrm{QUA}(\pi_2(P(x)))\rangle$

(5.59d) $[\![\text{fences}]\!]^{c_i} = \lambda x.\langle {}^{*}c_i(\mathbf{IND}(\mathrm{FENCE}))(x),\ \lambda y.c_i(\mathbf{IND}(\mathrm{FENCE}))(y), \varnothing\rangle$

(5.59e) $[\![\text{three fences}]\!]^{c_i} = \mathrm{MOD}([\![\text{three}]\!]^{c_i})([\![\text{fence(s)}]\!]^{c_i}) =$

$\lambda x.\langle {}^{*}c_i(\mathbf{IND}(\mathrm{FENCE}))(x), \mu_{card}(x, \lambda y.c_i(\mathbf{IND}(\mathrm{FENCE})(y)) = 3,$

$\mathrm{QUA}(\lambda y.c_i(\mathbf{IND}(\mathrm{FENCE}))(y))\rangle$

(Filip and Sutton 2017, p. 352)

Following Krifka (1989), pseudo-partitive measure DPs are assumed to sanction only non-quantized nominal arguments. *Fence* is sanctioned in pseudo-partitive measure DPs because this environment is assumed to apply the null counting schema to the nominal argument, and *fence* is non-quantized at the null counting context. *Cat*, on the other hand, is not sanctioned, because it denotes a non-disjoint set of individuated entities even at the null counting context and therefore fails the non-quantized precondition of

pseudo-partitive measure DPs:

(5.60a) $[\![\text{three}]\!]^{c_i} = 3$

(5.60b) $[\![\text{meters of}]\!]^{c_i} = \lambda n.\lambda P.\lambda d.\lambda x.$
$\langle \pi_1(P(c_0)(x)),\ \mu_m(x,d) = n,\ \neg\text{QUA}(\lambda y.\pi_1(P(c_0)(y)))\rangle$

(5.60c) $[\![\text{fence}]\!] = \lambda c.\lambda x.\langle c(\mathbf{IND}(\text{FENCE}))(x),\ \lambda y.c(\mathbf{IND}(\text{FENCE}))(y),\ \varnothing\rangle$

(5.60d) $[\![\text{three meters of fence}]\!]^{c_i} = [\![\text{meters of}]\!]^{c_i}([\![\text{three}]\!]^{c_i})([\![\text{fence}]\!]) = \lambda d.\lambda x.$
$\langle c_0(\mathbf{IND}(\text{FENCE}))(x), \mu_m(x,d) = 3,\ \neg\text{QUA}(\lambda y.c_0(\mathbf{IND}(\text{FENCE}))(y))\rangle$

(Filip and Sutton 2017, p. 353)

The analysis of Filip and Sutton (2017) captures why it is that nouns like *cat* are countable but unable to occur in pseudo-partitive measure DPs without being shifted. This analysis also shows that preconditions requiring quantization are useful for accounting for the compositional properties of nouns, and it shows that rich lexical structures are particularly beneficial when it comes to straightforwardly capturing these complex patterns of composition.

5.2.6.3 Measure based plural nouns in Greek

Inspired by the straightforward composition demonstrated with the rich lexical structures in Filip and Sutton (2017), in Erbach (2019), I apply the analysis of English singular nouns in Filip and Sutton (2017) to Greek. The lexical entries of *gata* ('cat') and *laspi* ('mud') resemble their English counterparts with respect to countability.

(5.61a) $[\![\textit{gata}]\!]^{c_i} = \lambda x.\langle c_i(\mathbf{IND}(\text{CAT}))(x),\ \lambda y.c_i(\mathbf{IND}(\text{CAT}))(y),\ \varnothing\rangle$

(5.61b) $[\![\textit{laspi}]\!]^{c_i} = \lambda x.\langle c_0(\text{MUD})(x),\ \lambda y.c_0(\text{MUD})(y),\ \varnothing\rangle$

One of the main goals in Erbach (2019) is a more uniform treatment of plural mass nouns than the split plurality approach of Acquaviva (2008); Alexiadou (2011) and Kouneli (2019). In Erbach (2019), Greek plural morphology composes with all singular nouns in the same way, (5.62). The first projection of plural morphology selects the first projection of the singular noun it modifies via the projection function π_1 and closes it under sum with the *-operation. Note that the definition of pluralization in this approach does not specify atoms as is done by Chierchia (2015). The second projection of the plural noun is identical to that of the singular, because plural morphology is assumed to have the projection function π_2 in its second projection. Because the second projection of singular and plural nouns are identical, and these projections are crucial to the countability of nouns, count nouns remain count and mass nouns remain mass in this analysis. Following

Krifka (1995) and Grimm (2013) in assuming that nouns contain a measure function, the third projection contains a function that measures the singular noun's counting base.

(5.62) $[\![\text{PL}]\!] = \lambda P.\lambda x.\langle^* \pi_1(P(x)),\ \pi_2(P(x)), \mu_{PL}(x.\lambda y.\pi_2(P(x)(y))) > n_k\rangle$

(5.63a) $[\![\textit{gates}]\!]^{c_i} = \lambda x.\langle^* c_i(\mathbf{IND}(\text{CAT}))(x),\ \lambda y.c_i(\mathbf{IND}(\text{CAT}))(y),$
$\mu_{PL}(x.\lambda y.c(\mathbf{IND}(\text{CAT}))(y)) > n_k\rangle$

(5.63b) $[\![\textit{laspes}]\!]^{c_i} = \lambda x.\langle^* c_0(\text{MUD})(x),\ \lambda y.c_0(\text{MUD})(y),$
$\mu_{PL}(x.\lambda y.c(\mathbf{IND}(\text{MUD}))(y)) > n_k\rangle$

In Erbach (2019) I assume that the plural measure function, μ_{PL}, is sensitive to whether or not the counting base of the noun being modified is quantized. As assumed by Krifka (1989, 1995) and Grimm (2013), count nouns are measured for cardinality of countable individuals. Mass nouns on the other hand are assumed to be measured in terms of what I call MAGNITUDE in Erbach (2019). MAGNITUDE corresponds to the size or extent of the substance in a certain context, with the intent of capturing the 'spread/scattered' sense argued for by Kouneli (2019), given a simple measure of surface area or volume of the substance insufficiently characterizes the use of plural mass nouns in Greek.

(5.64) $$\mu_{PL} = \begin{cases} \text{QUA}(\pi_2(P(x))) & \rightarrow \quad \mu_{CARDINALITY} \\ & \textit{else} \quad \mu_{MAGNITUDE} \end{cases}$$

This sensitivity means that, rather than glossing the measure function simply as μ_{PL}, the lexical entries of plural count and plural mass nouns can be further specified as in (5.65), where *gates* ('cats') is measured according to cardinality and *laspes* ('muds') is measured according to magnitude. The sensitivity to quantization prevents count nouns from being measured according to magnitude and mass nouns for being measured according to cardinality.

(5.65a) $[\![\textit{gates}]\!]^{c_i} = \lambda x.\langle^* c_i(\mathbf{IND}(\text{CAT}))(x),\ \lambda y.c_i(\mathbf{IND}(\text{CAT}))(y),$
$\mu_{CARDINALITY}(x,\ \lambda y.c_i(\mathbf{IND}(\text{CAT})(y))) > n_k\rangle$

(5.65b) $[\![\textit{laspes}]\!]^{c_i} = \lambda x.\langle^* c_0(\text{MUD})(x),\ \lambda y.c_0(\text{MUD})(y),$
$\mu_{MAGNITUDE}(x,\ \lambda y.c_0(\text{MUD}(y))) > n_k\rangle$

A remaining bit of data that must be accounted for is that which shows different amounts of rice and water sanction the use of plural mass nouns in different contexts. This is accounted for in the analysis in Erbach (2019) by the fact that the amount measured by plural morphology is context sensitive, n_k. It is assumed that this number will vary with respect to the QUD; for example the QUD pertaining to an otherwise empty pan of rice

will have a relatively low n_k, while the QUD pertaining to a pan full of rice will have a relatively high n_k. The QUDs, therefore, do the majority of the heavy lifting in this approach, given they contain a value of n_k that pertains to the context at hand and that determines whether or not the 'spread'/'scattered' inference is present.

The treatment of singular and plural nouns that I argue for in Erbach (2019) allows for the analysis of counting and measuring in Filip and Sutton (2017) to be upheld, because the counting base of count and mass nouns remain unchanged. Furthermore, because the non-disjointness based analysis of Sutton and Filip (2016b,c) and Filip and Sutton (2017) is being used, Greek is free to have object mass nouns so long as it has nouns that denote a non-disjoint set of individuals when interpreted at the null counting schema, as will be discussed below. Furthermore, assuming that the readings of plural nouns are determined by the QUD, as done in Grimm (2013), this measure based account is able to account for when the plural inference appears and when it does not.

5.3 Discussion of previous analyses

While each of the aforementioned analyses are able to account for some of the Greek data, there are unanswered questions in each analysis as well. Tsoulas (2008) presents the most comprehensive account of the Greek nominal system, addressing the mass/count distinction in respect to the occurrence of plural mass nouns and the potential existence of object mass nouns in Greek. He does not, however, address bare singular count nouns in Greek, and this practice is followed by subsequent analyses of plural mass nouns and object mass nouns in Greek (Alexiadou 2011, 2015; Chierchia 2015; Kane et al. 2015; Erbach 2019; Kouneli 2019). While the discussion of bare singular count nouns in Greek remains a body of work separate from work on the mass/count distinction in Greek, Chierchia (1998b) has argued that the occurrence of such bare singular count nouns has typological consequences, and from this we might consider whether or not the existence of singular count nouns in Greek predicts or can be predicted by other grammatical features of the Greek nominal system. In this spirit, this section discusses the extent to which the properties of the mass/count distinction in Greek can be predicted or accounted for in the aforementioned analyses. What will be seen is that, while all analyses leave certain questions unanswered, such as the distribution of bare singular count nouns in Greek, only the analyses of Tsoulas (2008) and Chierchia (2015) are seen to make predictions that are too strong with respect to the occurrence of object mass nouns in Greek. Alternatively, the analysis of Greek proposed I propose in Erbach (2019), which is based on the same analysis of the mass/count distinction argued for in Chapter 4 of this thesis, is able to straightforwardly account for object mass nouns given it builds on the non-disjointness

based analysis of Sutton and Filip (2016b,c) and Filip and Sutton (2017) that predicts object mass nouns should be able to arise in languages with a grammaticized lexical mass/count distinction that have nouns that refer to a non-disjoint set of individuated entities at the null counting schema.

5.3.1 Tsoulas (2008); Chierchia (2010, 2015)

The analyses of Tsoulas (2008) and Chierchia (2010, 2015) distinguish Greek number marking as weaker than that of English, answering the question why Greek has plural mass nouns while English does not. According to Chierchia (2015), number marking in Greek is not defined in terms of stable atoms, as number marking is defined in English, which means that singular mass nouns in Greek denote sets of unstable individuals and plural mass nouns denote the closure under sum of the respective sets. This set of assumptions has consequences for the existence of object mass nouns and for the interpretation of singular and plural nouns in Greek.

The consequences of the analyses of Chierchia (2015) and Tsoulas (2008) seem questionable in light of data from Greek. Because number marking is not defined in terms of stable atoms and therefore does not encode mass nouns as singleton properties in the analyses of Chierchia (2015) and Tsoulas (2008), they predict that Greek has no object mass nouns. In Tsoulas's (2008) analysis, singular nouns are marked [+singular] which results in the type shift of mass nouns from denoting complete semi-lattices to denoting kinds. While this parallels the type shift to singleton properties required by Chierchia (2010, 2015), the type shift argued for by Tsoulas (2008) is not supposed to be accessible via lexical choice to form object mass nouns, unlike the type shift required by Chierchia (2010, 2015). It is unclear why this might be the case or if it is even desirable given the argument of Alexiadou (2015) that Greek has object mass nouns. It is also unclear, given the analyses of Chierchia (2015) and Tsoulas (2008), how object mass nouns might arise, even exceptionally, given the fundamental apparatus for making object mass nouns, namely singular morphology defined in terms of stable atoms, is supposed to be absent from Greek. In sum, the predictions of Chierchia (2015) and Tsoulas (2008) seem to be too strong given Alexiadou's (2015) argument that Greek has at least two object mass nouns.

In addition to predicting a lack of object mass nouns, the analysis of Chierchia (2015) has several further consequences for the distribution of mass nouns in Greek. The assumption that singular mass nouns denote sets of unstable individuals in Greek means that these nouns should not be able to refer to massive bodies—e.g. *nero* ('water') should not be able to refer to a lake, or the sum of all water on earth—and also that these nouns should

not be cumulative—e.g. the sum of two unstable *nero* ('water') individuals should not also count as *nero* ('water'). These predictions seem too strong given there is no evidence of Greek speakers using *nero* ('water') in these ways. The assumptions about singular nouns in Greek made by Chierchia (2015) are too strong and do not seem to accurately reflect the distribution of nouns in Greek.

Though both Chierchia (2015) and Tsoulas (2008) focus on accounting for plural mass nouns in Greek, their analyses are not able to capture all of the data pertaining to these nouns that has been reviewed in this chapter. Because morphological pluralization corresponds strictly to closure under sum under the analysis of Chierchia (2015), he provides no account of the inference associated with plural mass nouns. Furthermore, neither Chierchia (2015) nor Tsoulas (2008) provide a means by which they might account for the contextual restrictions on when plural mass nouns are appropriate. Despite lacking accounts for certain characteristics of plural mass nouns in Greek, both Chierchia (2015) and Tsoulas (2008) could accommodate the new data with relatively simple additions to their existing accounts.

Both ways in which these theories are lacking with respect to plural mass nouns, might be accounted for by adopting more recent analyses. For example, the 'much' inference argued for by Tsoulas (2008) could be changed to the 'spread/scattered' inference argued for by Kouneli (2019) and could perhaps also incorporate the scalar implicature account of Kane et al. (2015) in order to be compatible with the rest of the available data. Alternatively, the intersective analysis that Tsoulas (2008) argues for might be interpreted along the lines of the measure based analysis argued for by Erbach (2019) to account for the readings of plural mass nouns.

The analysis of number marking and object mass nouns in Chierchia (2010, 2015) could be used to account for a lack of object mass nouns in Greek if the original claims from Tsoulas (2008) could be upheld, though doubt has been cast on this by Alexiadou (2015). Given the evidence that suggests Greek has object mass nouns, it seems that the analysis of Greek by Chierchia (2015) is too restrictive. In order to maintain this approach to object mass nouns, future work might assume that Greek does in fact have a strong singular, defined in terms of stable atomicity and therefore able to act as the driving force for object mass nouns to arise via lexical choice. This would also mean that, unlike the analysis proposed in Chierchia (2015), *nero* ('water') would be able to refer to the sum of all water on Earth, and this and other mass nouns would be cumulative, as they should be. The strong singular, in tandem with the weak definition of plurality in Greek, namely that it is not defined strictly with respect to stable atoms, can account for the fact that both count and mass nouns pluralize in Greek, though the meaning of plural mass nouns would be semantically identical to that of singular mass nouns given the closure

under sum of a singleton is still a singleton thereby violating Chierchia's assumption that morphological pluralization is not semantically vacuous. A scalar implicature account of the inference accompanying plural mass nouns could then be adopted, which fits with Chierchia's (2010) suggestion that such an implicature is responsible for the patterns of inclusive and exclusive readings of plural count nouns.

While Chierchia (2010, 2015) gives an account for why certain nouns are mass and others are count (unlike the previous analysis (Chierchia 1998a)), this account cannot explain why a noun might be mass in one language but count in another as is the case for *furniture* in English and *meuble(s)* in Dutch. With respect to object mass nouns, the lexical choice to encode stably atomic nouns as singleton properties means there should be no way to predict which nouns will, or will not be object mass in a given language. This is incompatible with the assumptions of Barner and Snedeker (2005), Landman (2011), and Sutton and Filip (2016b) who have shown that superordinate terms and nouns that denote sets of non-disjoint individuals are often those that are object mass, while object denoting nouns without these properties are not. In fact, lexical choice could theoretically be applied to every single stably atomic noun, resulting in a language where every noun is encoded as mass. This is similar to what is argued to be the case in classifier languages, as will be seen in Chapter 7, though with a different definition of what it means to be mass.

Continuing to look beyond Greek and English, the strong and weak definitions of number marking argued for by Chierchia (2010, 2015) cannot be applied to languages like Hungarian. As will be seen in Chapter 6, singular nouns in Hungarian have been argued to have semantically plural reference, and therefore be number neutral (Farkas and de Swart 2010; Erbach et al. 2019). It cannot be the case, then, in Hungarian that singular nouns are defined with respect to even a weak notion of atomicity. Beyond Hungarian, there are many other languages with number marking that, at least at first glance, do not fit into definitions of singular and plural marking argued for by Chierchia (2010, 2015). For example, all mass nouns are always plural in Lingala (Bantu) (Ojeda 2005), but only some mass nouns are always plural in Zuni (Newman 1965), Syrian Arabic (Cowell 1974), and Akebu (Kwa) (Makeeva and Shluinsky 2018). So, while the Greek data from Alexiadou (2015) alone does not necessarily present an insurmountable problem for the analyses of Tsoulas (2008) and Chierchia (2015), the manifestation of plural morphology in other languages would require a different analysis entirely.

5.3.2 Acquaviva (2008); Alexiadou (2011, 2015); Kouneli (2019)

The approaches of Alexiadou (2011) and Kouneli (2019) distinguish plural mass nouns in Greek as lexical plurals that simply do not occur in languages like English, leaving Alexiadou (2011) and Kouneli (2019) free to adopt any analysis of the mass/count distinction, though the choice for Alexiadou (2011) would be restricted to one that is compatible with the distributional morphology based analysis of object mass nouns in Greek she argues for in Alexiadou (2015). At first glance, any analysis of the mass/count distinction that allows object mass nouns in number marking languages seems as though it might be applicable, though further work is certainly necessary to explore compatibility of accounts.

The evidence that Alexiadou (2015) uses to argue that Greek has object mass nouns is not particularly robust, even in light of the relatively small number of tests for the mass/count distinction that (Tsoulas 2008) describes in Greek. Alexiadou (2015) shows that *epiplosi* ('furniture') has plural reference in the singular and can accept stubbornly distributive determiners, showing that it has at least two properties of object mass nouns. However, we never see whether or not this noun is felicitous in counting constructions or with the count determiner *kathe* ('every'), though we would have to assume that *epilosi* ('furniture') is infelicitous in these morphosyntactic environments given Alexiadou (2015) claims this noun is object mass. The data pertaining to *ruhismos* ('clothing') is even less robust given that Alexiadou (2015) only shows that this noun cannot be shifted to a kind or portion interpretation with plural morphology. While lacking the ability to be shifted is described as a characteristic property of object mass nouns by Sutton and Filip (2018), demonstrating other object mass properties of *ruhismos* ('clothing') would be helpful in demonstrating the robustness of this otherwise small class of object mass nouns in Greek.

Further work is also necessary to explore the extent to which all of the data on plural mass nouns discussed in this chapter can be accounted for with a lexical approach to plural mass nouns in Greek. In such an approach, the inference associated with plural mass nouns in Greek is accounted for as part of idiosyncratic meaning of this type of lexical plural, either meaning 'a lot of' (Alexiadou 2011) or 'spread/scattered' (Kouneli 2019). The fact that a singular mass noun and its lexically plural counterpart are fundamentally two different nouns that share a common root can account for the fact that plural mass nouns are only appropriate in certain contexts—e.g. rice scattered across or filling a pan—if these contextual specifications are assumed to be part of the meaning of the lexical plurals. This sort of approach, however, does not seem compatible with the evidence from Kane et al. (2015), that the inference disappears in downward entailing contexts. It is also unclear if the approach is compatible with instances where plural mass

nouns refer to large bodies like 'the waters of the Saronic Gulf', which Acquaviva (2008) claims are lexical plurals in English. Proponents of the lexical approach to plural mass nouns in Greek would therefore have to assume that either (i) 'spread/scattered' plural mass nouns are distinct from these 'abundance' plural mass nouns—in which case there are two distinct, but homonymous lexical plurals *nera* ('waters')—or, (ii) that both are the same sort of lexical plural, albeit with one that varies from context to context. While a lexically based approach to plural mass nouns in Greek needs to be explored further for ability to account for the relevant data, such and approach seems straightforwardly compatible with any semantic analysis of object mass nouns, be it that of Landman (2011, 2016), Rothstein (2010), Sutton and Filip (2016b), etc., because this approach to plural mass nouns in Greek makes no predictions about the existence of object mass nouns.

5.3.3 Kane et al. (2015)

While the scalar implicature account captures the (dis)appearance of the accompanying inference in the available data, the semantic basis of the analysis by Kane et al. (2015) requires morphological pluralization to be entirely semantically redundant on mass nouns, and it is not clear exactly how this account would be able to accommodate the data the suggests Greek has two or more object mass nouns. Though this could serve to characterize the distinction between Greek and English, it is unclear why Greek would accept this redundancy and English would not. At the same time, because plural count nouns and mass nouns both denote complete semi-lattices, there is no way to semantically distinguish potential object mass nouns from plural count nouns, with the exception of morphological pluralization on the latter. In order to accommodate the data from Alexiadou (2015) on object mass nouns in Greek, Kane et al. (2015) could assume that object mass nouns simply enter the lexicon as a complete semi-lattice, though they would not be able to predict that plural morphology is ungrammatical on *ruhismos* ('clothing') or why the atoms denoted by object mass nouns are not countable. Because it is not clear how the nominal semantics assumed by Kane et al. (2015) might include object mass nouns, the scalar implicature analysis of plural mass nouns in Greek that they argue for might be best applied to another analysis of the mass/count distinction, particularly one that would predict that object mass nouns can occur in Greek.

The analysis of Kane et al. (2015) is meant to account for when the inference that accompanies plural mass nouns does and does not occur, and this analysis does so in a relatively straightforward manner, namely by evoking the analysis of scalar implicature in Spector (2007). It is unclear, however, how Kane et al. (2015) would account for the contextual restrictions on plural mass nouns, namely that a 'much' inference might

occur when describing rice scattered across a pan after a meal, but not when the pan is full of rice before the meal begins. A potential remedy for this problem is replacing the 'much' inference with the 'spread/scattered' interpretation of the inference from Kouneli (2019). Instances where plural mass nouns refer to large bodies might then be relegated to lexical pluralization, or they might be treated as the same phenomenon with a somewhat different notion of 'spread/scattered'.

5.3.4 Erbach (2019)

The analysis I argued for in Erbach (2019) not only captures much of the data on plural nouns in Greek, but it also straightforwardly allows and can account for the presence of object mass nouns in Greek as it is based on the non-disjointness based analysis of the mass/count distinction by Sutton and Filip (2016b,c) and Filip and Sutton (2017), which does not restrict the occurrence of object mass nouns to any particular type of language other than those that have a grammaticized lexical mass/count distinction. The nouns argued to be object mass by Alexiadou (2015) can straightforwardly be analyzed as nouns interpreted at the null counting schema and denoting a non-disjoint (mass) counting base.

(5.66a) $[\![\textit{ruhismos}]\!]^{c_i} = \lambda x.\langle {}^*c_0(\mathbf{IND}(\text{CLOTHING}))(x), \lambda y.c_0(\mathbf{IND}(\text{CLOTHING}))(y),\ \varnothing\rangle$

(5.66b) $[\![\textit{epiplosi}]\!]^{c_i} = \lambda x.\langle {}^*c_0(\mathbf{IND}(\text{FURNITURE}))(x), \lambda y.c_0(\mathbf{IND}(\text{FURNITURE}))(y),\ \varnothing\rangle$

Unlike Chierchia (2010, 2015) this analysis of nominal semantics does not assume that singular nouns are defined in terms of stable atoms, hence the presence of the * operation in the first projection of the lexical entries above, which allows *ruhismos* ('clothing') and *epilosi* ('furniture') to refer to individual pieces of clothing and furniture and sums thereof respectively. The second projections, the counting bases, of these nouns are not disjoint because they are interpreted at the null counting context, which functions as the identity function on the set of individuated entities in the extension of the general number nominal root, a set which is non-disjoint itself. These properties make *ruhismos* ('clothing') and *epilosi* ('furniture') object mass nouns, and show that this analysis of countability is straightforwardly compatible with Greek so long as a sufficient account of plural mass nouns is also assumed.

In addition to capturing object mass nouns in Greek, the analysis argued for in Erbach (2019) captures the (dis)appearance of the accompanying inference in the available data by assuming a question under discussion (QUD) based analysis of plural interpretation as

in Grimm (2013), which relies on the QUD to determine the reading of a plural noun in a particular context. Furthermore, this analysis captures the fact that different amounts of a substance can count as enough to warrant the use of a plural mass nouns with the context sensitive measurement of the nouns counting base that is also determined by the QUD. Despite the fact that a measure and QUD based analysis can account for the data in in Greek, there is currently not any data with readings of plural mass nouns in Greek along the lines of those in English that Grimm (2013) uses to argue against the scalar implicature based account of count nouns. It is therefore unclear if this measure based account is necessary to account for the phenomenon while the scalar implicature based account still seems sufficient. At the same time, however, the analysis proposed by Erbach (2019) can straightforwardly account for object mass nouns in Greek—i.e. they are interpreted at the null counting schema, meaning it can capture more data than the existing version of the scalar implicature based approach. One caveat for all analyses other than the lexical plural based accounts of Alexiadou (2011) and Kouneli (2019) is the claim of Alexiadou (2015) that *ruhismos* ('clothing') cannot take plural morphology at all.

5.4 Implications from the discussion of Greek

While the analyses of Tsoulas (2008), Alexiadou (2011), Chierchia (2015), Kane et al. (2015), Erbach (2019), and Kouneli (2019) each propose an underlying explanation for why plural mass nouns occur in Greek, those of Tsoulas (2008) and Chierchia (2015) are too restrictive given the fact that, according to Alexiadou (2015), Greek has object mass nouns. The analysis proposed by Erbach (2019), being based on the context sensitive, non-disjointness based analysis of the mass/count distinction of Sutton and Filip (2016b,c, 2018) and Filip and Sutton (2017), accurately predicts that object mass nouns can exist in Greek, and that these nouns denote sets of non-disjoint individuals. The existence of object mass nouns in Greek has therefore been shown to constitute a testing ground for the theories of the mass/count distinction motivated by Chierchia (2015) and Sutton and Filip (2016b,c, 2018, 2019) and Filip and Sutton (2017).

This chapter has revealed many ways in which Greek, a number marking language, is significantly different from other number marking languages. First and foremost, Greek allows plural morphology to occur on mass nouns (possibly without restrictions), and in this way alone, Greek is different from English as has been the focus of arguments by Tsoulas (2008) and Chierchia (2015). Second, Greek allows bare singular count nouns to occur in a number of environments, which is also unlike English but somewhat similar to classifier languages, like Mandarin and Japanese, which allow bare nouns freely. Third,

Greek seems to have very few object mass nouns, though the evidence of these nouns from Alexiadou (2015) is not particularly robust. This coincides with the fact that there has been no thorough exploration of the characteristics of the mass/count distinction in Greek along the lines of those in English like Allan (1980) and Kiss et al. (2016). Tsoulas (2008) mentions that many determiners are compatible with both count nouns and mass nouns, and there do not seem to be any that are only compatible with mass nouns as is the case with *much* and *little* in English. While Greek is a language with a clear mass/count distinction, this distinction is not as robustly demonstrated morphosyntactically as English, and it aligns much more closely with the substance/object distinction than English. In other words, it seems that Greek has few object mass nouns and relatively few morphosyntactic environments sensitive to the countability of nouns, which supports the main hypothesis of this thesis that there is a relationship between the number of object mass nouns and and the number morphosyntactic environments sensitive to the countability of nouns in a given language.

Despite the respective ability of analyses of Greek to capture the relevant phenomena, there is no explanation in any of these accounts as for why the Greek nominal system is different than the English nominal system with respect to plural morphology. Further research might reveal whether or not there is a relationship between components of the Greek nominal system that are fundamentally different from those in English and give rise to the occurrence of plural mass nouns in Greek. A closer look plural mass nouns, bare singular nouns, the distribution of quantifiers, determiners, and how freely mass/count shifts occur, might lead to an answer that follows from the nominal system in Greek.

Chapter 6

Hungarian

Several analyses of Hungarian have argued that all object denoting nouns have mass denotations (Csirmaz and Dékány 2014; Rothstein 2017; Schvarcz and Rothstein 2017)[1]. In other words, it has been claimed that all object denoting nouns are object mass nouns in Hungarian. The primary reason for such claims is that Hungarian has a classifier system that can be used to count all object denoting nouns. These analyses treat Hungarian classifier constructions as the same as those in classifier languages like Japanese and Mandarin as analyzed by, for example Chierchia (1998a).

However, as argued by Rothstein (2017) and Schvarcz and Rothstein (2017), Hungarian also has a robust mass/count distinction. The mass/count distinction in Hungarian, can be seen with the typical tests, namely in the distribution of plural morphology, direct numeral attachment, and determiners (Rothstein 2017; Schvarcz and Rothstein 2017). It has also been argued that Hungarian bare nouns are number neutral (Farkas and de Swart 2010; Erbach et al. 2019) given bare singular nouns freely occur with determiners like *több* ('more') and *mindenféle* ('all kinds of'). Furthermore, Erbach et al. (2019) show that not all object denoting nouns display the characteristic behavior of mass nouns in certain contexts, namely having plural reference with the definite article. Erbach et al. (2019) claim that it is not the case that all object denoting nouns have a mass denotation in Hungarian, rather Hungarian has a relatively small but distinct class of nouns with object mass denotations, and a class of count nouns relatively similar in size to number marking languages like English.

The evidence from Erbach et al. (2019) of a small class of nouns with only object mass denotations serve as a testing ground for theories of the mass/count distinction

[1]Rothstein (2017) and Schvarcz and Rothstein (2017) actually argue that **almost** all object denoting nouns have mass denotations and that there are two object denoting nouns that are true mass nouns. These points will be reviewed below

in Hungarian. This data shows that it cannot be the case that all countable nouns in Hungarian can be analyzed as having an object mass denotation, contra Csirmaz and Dékány (2014); Rothstein (2017) and Schvarcz and Rothstein (2017), because not all countable nouns behave as object mass nouns do in morphosyntactic environments diagnostic of mass nouns. Instead it is nouns that only have an object mass denotation and a small set of dual-life nouns that exhibit this behavior. This data is predictable on the context sensitive, non-disjointness based analysis of the mass/count distinction argued for in this thesis and by Erbach et al. (2019).

6.1 Hungarian data

The Hungarian nominal system has the hallmark properties of a system with a grammaticized lexical mass/count distinction (Rothstein 2017; Schvarcz and Rothstein 2017). For example, the availability of plural morphology can be used to distinguish count nouns from mass nouns as is often assumed to be the case in English.

(6.1) rózsa / rózsá-k
rose / rose-PL
'rose/roses' (Schvarcz and Rothstein 2017, p. 185)

(6.2) *kosz-ok
dirt-PL
'dirts' (Schvarcz and Rothstein 2017, p. 193)

The distribution of Hungarian numerical determiners distinguishes mass nouns and count nouns as well, as only object denoting nouns can straightforwardly combine directly with numericals.

(6.3) három könyv(*-ek)
three book(*-PL)
'three books' (Schvarcz and Rothstein 2017, p. 185)

(6.4) *három kosz
three dirt
'three dirts' (Schvarcz and Rothstein 2017, p. 193)

As in English, nouns that refer to substances cannot directly occur with a numerical unless it is shifted to a kind or portion interpretation or occurs with a classifier.

(6.5) három *(darab) sár
three $\text{CL}_{general}$ mud
'three pieces of mud' (Schvarcz and Rothstein 2017, p. 194)

Unlike English, however, classifiers can also occur with nouns that can otherwise directly combine with numericals.

(6.6) a. hét (fej) saláta
seven CL_{head} lettuce
'seven lettuces'

b. hét (szem) cukor
seven CL_{eye} candy
'seven pieces of candy'

c. hét (szál) gyertya
seven CL_{thread} candle
'seven candles' (Csirmaz and Dékány 2014, p. 150)

The distribution of classifiers in Hungarian will be described in more detail in Section 6.1.2. Despite the fact that classifiers can be used with nouns that can otherwise directly combine with numericals, direct combination with numericals still seems to be a sufficient test for the mass/count distinction in Hungarian.

The determiner system also serves to uncover the mass/count distinction in Hungarian. For example, Rothstein (2017) and Schvarcz and Rothstein (2017) show the Hungarian WH-quantifier *hány* ('how many') is ungrammatical with mass nouns.

(6.7) *hány szemét/ sár/ kosz?
how.many trash mud dirt
'How many trash/mud/dirt?' (Schvarcz and Rothstein 2017, p. 195)

Count nouns straightforwardly compose with *hány* ('how many'), though, unlike the equivalent English expression, only singular count nouns are grammatical in this construction.

(6.8) hány könyv(*-ek)?
how.many book(*-PL)
'How many books?'[2]

What is less clear is whether or not Hungarian has any determiners that are only grammatical with mass nouns. Schvarcz and Rothstein (2017), for example, argue that

[2]Special thanks to my Hungarian consultants, including Zsofia Gyarmathy, Károly Varasdi, and Katalin Balogh, for the original data presented in this thesis.

mennyi ('what quantity of') is infelicitous with certain count nouns like *fej* ('head'), though Gyarmathy (2016) argues that, on her judgment of examples, *mennyi* ('what quantity of') does not distinguish count nouns from mass nouns in any way. While the data is unclear for certain countable nouns, what seems to be straightforwardly accepted in Hungarian is both a cardinality and, for example, a weight based interpretation of most countable nouns. For example, the question constructed with *mennyi* ('what quantity of') in (6.9-a) can be answered with a weight based measurement (6.9-b) or a cardinality based measurement (6.9-c).

(6.9) a. Menny könyv-et tudsz cipelni?
what.quantity book-ACC able.PRES.2SG carry.INF
'What quantity of books can you carry?'

b. Három kiló-t.
three kilo-ACC
"Three kilos.'

c. Hárma-t
three-ACC
'Three.' (Schvarcz and Rothstein 2017, p. 200)

The same is not true for nouns that refer to substances like *sár* (mud), which only get measure based readings when composed with *mennyi* ('what quantity of').

(6.10) mennyi szemét/ sár/ kosz?
what.quantity.of trash mud dirt
'What quantity of trash/mud/dirt?' (Schvarcz and Rothstein 2017, p. 195)

Unlike English, where plural count nouns and mass nouns are felicitously used in pseudo-partitive (measure) DPs[3], singular count nouns and mass nouns are used in pseudo-partitive (measure) DPs in Hungarian, and plural count nouns are not.

(6.11) Ki cipelte fel a harminc kg könyvet?
who hauled up the thirty kg book.SG.ACC
'Who hauled the thirty kilos of books upstairs?' (Erbach et al. 2019)

(6.12) Margit 20 kiló homok-ot vett.
Margit 20 kilo sand-ACC bought
'Margit bought twenty kilos of sand.'

Both singular count nouns and mass nouns are also acceptable with certain determiners in Hungarian. Farkas and de Swart (2010) show that singular, but not plural count

[3]Singular count nouns are only felicitous with a humorous or universal grinder reading.

nouns occur with *sok* (‘a lot of’), *mindenféle* (‘all kinds of’), *több* (‘more’), and *egy pár* (‘a couple of’).

(6.13) a. sok gyerek / *gyerekek
many child / child.PL
‘many children’

b. mindenféle gyerek / *gyerekek
all.kind child / child.PL
‘all kinds of children’

c. több gyerek / *gyerekek
more child / child.PL
‘more children’

d. egy pár gyerek / *gyerekek
a couple child / child.PL
‘couple of/some children’ (Farkas and de Swart 2010, p. 10)

Sok (‘a lot of’), mindenféle (‘all kinds of’), *több* (‘more’) are also felicitous with mass nouns, though *egy pár* (‘a couple of’) is not.

(6.14) Sok homokot vettem.
a.lot.of sand bought.1SG
‘I bought a lot of sand.’

(6.15) több sár
more mud
‘more mud’

(6.16) mindenféle szemét
all.kinds.of garbage
‘all kinds of garbage’

(6.17) #egy pár sár
one couple mud
#‘a couple of mud’

The data show that, while Hungarian has a mass/count distinction, there are ways in which mass nouns and count nouns have a more similar distribution in Hungarian than they do in English. The use of bare singular count nouns in Hungarian is unlike English and more similar to classifier languages like Japanese and Mandarin. The same is true of the fact that bare singular nouns are used with determiners like *sok* (‘many’) and *több* (‘more’). On the other hand, like English and unlike classifier languages, Hungarian shows many characteristics of mass/count distinction namely direct combination of count

nouns with numericals, count specific determiners, and plural morphology that occurs freely on count nouns but not on mass nouns.

6.1.1 Nominal arguments in Hungarian

While the existence of nominal arguments are not used as a test or indication of a mass/count distinction in a given language, Chierchia (1998b) has shown that classifier languages like Mandarin freely allow bare nominal arguments to occur, while number marking languages like English only allow certain nouns to occur as nominal arguments, namely mass and plural count nouns, while number marking languages like Italian, generally do not allow bare nouns to occur at all. Building on this distinction, the existence of freely occurring bare nouns in a given language, in addition to the manner in which the language exhibits a mass/count distinction (if at all) can show whether or not the language patterns more strongly with classifier languages or number marking languages.

Hungarian does not freely allow bare singular nouns to occur, though they are allowed in certain environments. Bare nouns most freely occur in the accusative case, though in this position they are considered to be pseudo-incorporated, meaning that the thematic arguments of the noun and the verb they occur with are unified (Farkas and De Swart 2003). Bare singular nouns do not freely occur in the nominative case, though they can occur with certain verbs (Rounds 2013). In (6.18), for example, *könyv* ('book') in the nominative case can be interpreted as referring to individual books and also sums thereof as shown by the additional numerical.

(6.18) könyv érkezett. Négy.
book.SG.NOM arrived.3SG four
'(A) Book(s) arrived. Four.' (Erbach et al. 2019)

Similarly, in (6.19) the singular count noun *pillangó* ('butterfly') in the translative case is interpreted as entailing that one or more butterflies have undergone a complete transformation from caterpillars.

(6.19) Láttuk, ahogy a hernyók pillangó-vá váltak.
see.1PL.PST as the caterpillar.PL butterfly.SG-TRANS become.3PL.PST
'We saw the caterpillars become butterflies.' (Erbach et al. 2019)

In allowing bare singulars to be used as predicates, albeit with restrictions, Hungarian is more like classifier languages like Japanese than number marking languages like English.

6.1.2 Classifiers in Hungarian

Csirmaz and Dékány (2014) distinguish three groups of classifiers in Hungarian: sortal, group, and measure classifiers. Sortal classifiers are those categorize nouns according to shape and size (6.20), group classifiers refer to a set of objects in a functional unit (6.21), and measure classifiers name a container or unit of measure (6.22), and they occur with object and substance denoting nouns.

(6.20) öt fej káposzta / saláta / karfiol
five CL$_{head}$ cabbage / lettuce / cauliflower
'five heads of cabbage / lettuce / cauliflower'
(Csirmaz and Dékány 2014, p. 144)

(6.21) egy csomó zöldhagyma
a CL$_{bunch}$ green.onion
'a bunch of green onions' (Csirmaz and Dékány 2014, p. 144)

(6.22) hét kanál gyógyszer
seven CL$_{spoon}$ medicine
'seven spoons of medicine' (Csirmaz and Dékány 2014, p. 144)

Hungarian also has a classifier that can occur with many nouns, *darab* (CL), and it has been called a general classifier by Csirmaz and Dékány (2014); Rothstein (2017) and Schvarcz and Rothstein (2017). According to Csirmaz and Dékány (2014), *darab* (CL) can occur with any noun that can directly occur with a numerical.

(6.23) két szál / darab rózsa
two CL$_{thread}$ / CL$_{general}$ rose
'two roses' (Csirmaz and Dékány 2014, p. 149)

(6.24) három darab könyv
three CL$_{general}$ book
'three books' (Schvarcz and Rothstein 2017, p. 185)

It has also been argued that *darab* (CL) can also occur with substance denoting nouns (Csirmaz and Dékány 2014; Rothstein 2017; Schvarcz and Rothstein 2017).

(6.25) három darab szemét
three CL$_{general}$ dirt
'three pieces of dirt' (Rothstein 2017, p. 164)

However, consultants interviewed in conjunction with this thesis only permit *darab* to occur with substance nouns when the substance referred to is hardened, that is, it cannot be soft or liquid. This means that the reading of (6.25), would be 'three hard clumps of dirt'. This explains why (6.26) is judged to be strange by consultants.

(6.26) ?Összegyűjtöttem hat darab vér-t
collected six $\text{CL}_{general}$ blood-ACC
Intended: 'I collected six drops of blood.'

A possible reading of (6.26) is one in which the blood has dried in spots, for example, on a floor, and have been scraped away by the speaker.

Csirmaz and Dékány (2014) note that certain nouns can be counted with a classifier of each type: sortal, group, and measure. While (6.22) shows *gyógyszer* ('medicine') with a measure classifier, (6.27-a) shows the same noun with a sortal classifier, and (6.27-b) shows it with a group classifier.

(6.27) a. hét szem gyógyszer
seven CL_{eye} medicine
'seven pills'

b. hét levél gyógyszer
seven CL_{strip} medicine
'seven strips of pills' (Csirmaz and Dékány 2014, p. 144)

In addition to co-occurring with numericals, Hungarian classifiers can also occur with determiners, though they cannot occur with the definite article nor can they occur alone with the bare noun (Csirmaz and Dékány 2014).

(6.28) a. sok fej saláta
many CL_{head} lettuce
'many lettuces'

b. az a fej saláta
that the CL_{head} lettuce
'that (head of) lettuce'

c. *a fej saláta
the CL_{head} lettuce
'the (head of) lettuce'

d. *fej saláta
CL_{head} lettuce
'(head of) lettuce' (Csirmaz and Dékány 2014, p. 145–146)

Though classifiers cannot occur alone with a bare noun, (6.28-d), they can occur without a noun when used anaphorically with a demonstrative:

(6.29) az a szem
that the CL$_{eye}$
'that one'
(reference contextually determined) (Csirmaz and Dékány 2014, p. 150)

Csirmaz and Dékány (2014) note several key differences between Hungarian and classifier languages like Mandarin. The first is that classifiers are optional for nouns that refer to objects. Second, not all nouns can be counted with a classifier other than the general classifier. *Ceruza* ('pencil'), for example, can be counted directly with a numerical or with *darab* (CL), but there is no other classifier that can be used for counting individual pencils. A third difference is that Hungarian has far fewer classifiers than a language like Mandarin. Csirmaz and Dékány (2014) list 18 classifiers for counting individuals, while Zhang (2007) reports there are 902 total classifiers in Mandarin.

6.1.3 Object mass nouns in Hungarian

The existence of object mass nouns in Hungarian is somewhat controversial, and very different arguments have been made. On one hand, Csirmaz and Dékány (2014) have argued that all nouns are mass in Hungarian, and Rothstein (2017) and Schvarcz and Rothstein (2017), have argued that almost all count nouns are dual-life, meaning that all of these nouns have both mass and count denotations, the mass denotation being object mass. Gyarmathy (2016), on the other hand, has suggested that Hungarian lacks object mass nouns entirely. Erbach et al. (2019) have taken another position, suggesting that a small number of object denoting nouns have an object mass reading, as can be seen in at least one context. This section will review the relevant data, and the analyses of Csirmaz and Dékány (2014); Rothstein (2017); Schvarcz and Rothstein (2017) and Erbach et al. (2019) will be reviewed below.

The data that Erbach et al. (2019) use in support of their claim is that in which object denoting nouns compose with the definite article. The prediction, like that used with respect to Greek by Alexiadou (2015), is that mass nouns, when composed with the definite article can have plural reference, while singular count nouns can only have singular reference. If all countable nouns like *könyv* ('book') had an object mass denotation, then it should be the case that, when composed with the definite article, they can refer to a single individuated entity or uncountable sums thereof, whichever its the greatest element

in the context. This prediction is not borne out, however. With a definite determiner, *könyv* ('book') can only refer to a single book.

(6.30) A könyv 2kg-ot nyom.
the book 2kg-ACC weigh
'The book weighs 2 kilograms.' (only refers to one book) (Erbach et al. 2019)

There is, however, a small number of nouns that refer to objects that can get an object mass reading in this context: *lőszer* ('ammunition'), *felszerelés* ('equipment'), and *csomagolás* ('packaging'). Each of these nouns can equally felicitously refer to one or more than one object depending on the situation as in (6.31).

(6.31) A lőszer 2kg-ot nyom.
the ammunition 2kg-ACC weigh
'The ammunition weighs 2 kilograms.' (e.g. one or several pieces)
(Erbach et al. 2019)

Adding to the evidence from Erbach et al. (2019), in elicitations with consultants, I have also found that these nouns are infelicitous in three environments diagnostic of count nouns: direct composition with numericals, composition with the count WH-quantifier *hány* ('how many'), and composition with plural morphology. Each of these nouns are generally not counted without a classifier as shown in (6.32), nor do they felicitously occur with *hány* ('how many') (6.33) or the plural suffix *-k* .

(6.32) a. Három #(darab) lőszert számoltam.
three piece ammunition.ACC count.1SG.PST
'I counted three pieces of ammunition.'

b. Három #(doboz) felszerelést hoztunk.
three box equipment.ACC buy.1SG.PST
'We brought three boxes of equipment.'

c. Három #(darab) csomagolást dobtam ki.
three piece packaging.ACC throw.1SG.PST out
'I threw away three pieces of packaging.'

(6.33) a. #Hány löszer van a táskádban?
how.many ammunition be.there DEF bag.POSS.2ND
#'How many ammunition are in your bag?'

b. #Hány felszerelés van a táskádban?
how.many equipment be.there DEF bag.POSS.2ND
#'How many equipment are in your bag?'

c. #Hány csomagolás van a táskádban?
how.many packaging be.there DEF bag.POSS.2ND

#‘How many packaging are in your bag?’

(6.34) a. #löszer-ek
ammunition-PL
#‘ammunitions’

b. #felszerelés-ek
equipment-PL
#‘equipments’

c. #csomagolás-ak
packaging-PL
#‘packagings’

These three grammatical tests provide further support for an analysis in which these nouns are object mass nouns.

In quantity comparison tasks, consultants respond with cardinality judgments for each of these nouns in the following contexts.

(6.35) a. Alex has three 9mm bullets for his pistol and Charlie has two 12-gauge shotgun shells.

b. Ki rendelkez-ik több lőszerrel?
who have-3SG more ammunition
‘Who has more ammunition?’

(6.36) a. Jess and Rory are going hiking in the mountains. Jess has a one liter water-bottle and a map, while Rory has a 100ml bottle of insect repellent, a 100ml bottle of sunblock, a flashlight, and a lighter.

b. Kinek van több felszerelése?
who-ACC have more equipment
‘Who has more equipment?’

(6.37) a. Sam has seven meters of wrapping paper and five boxes that are 10cm x 10cm x 10cm each. Chris has eight meters of wrapping paper and one box that is 50cm x 50cm x 50cm.

b. Kinek van több csomagolása?
who-ACC have more packaging
‘Who has more packaging?’

Because cardinality judgments are available for *lőszer* (‘ammunition’), *felszerelés* (‘equipment’), and *csomagolás* (‘packaging’), it is possible to assume that these nouns denotes objects as opposed to substances, following Bale and Barner (2012). The grammatical

tests in conjunction with the quantity comparison test motivate the conclusion that these are object mass nouns.

6.1.4 Dual-life nouns in Hungarian

In addition to showing that Hungarian has a set of object denoting nouns that cannot be used in count morphosyntax, further elicitations have revealed that Hungarian has a set of object denoting nouns that can be used in count morphosyntax and have plural reference when arguments of the definite article. *Kő* ('stone') and *tégla* ('brick'), for example, can combine directly with numerical determiners, (6.39), and they can combine with the count WH-quantifier *hány* ('how many'), (6.39).

(6.38) a. Három követ vett-em fel a kirándulás-om során.
three stone.ACC took-1SG up the hike-1SG.POSS in.the.course.of
'I picked up three stones on my hike'

b. Két tégla nyit-ott-a meg az ajtót.
two brick open-PST-3SG meg the door.ACC
'Two bricks held open the door'

(6.39) a. Hány követ vásárolt?
how.many stone.acc buy.PST.3SG
'How many stones did you buy?

b. Hány téglát vásárolt?
how.many brick.acc buy.PST.3SG
'How many bricks did you buy?

At the same time, these nouns can be used in singular to refer to one or many objects.

(6.40) a. A követ a sétány mellett helyezt-em el.
the stone.ACC the walkway next.to place.PST-1SG.POSS aside
'I put the stone next to the walkway.' (A single stone or a pile of stones)

b. A téglát a sétány mellett helyezt-em el.
the brick.ACC the walkway next.to place.PST-1SG.POSS aside
I put the brick next to the walkway.' (A single brick or a pile of bricks)

Though the sentences in (6.40) are acceptable, they are reportedly more natural sounding if *kő* ('stone') and *tégla* ('brick') occur with plural morphology, as in (6.41).

(6.41) a. A köveket a sétány mellett helyezt-em el.
the stone.PL.ACC the walkway next.to place.PST-1SG.POSS aside
'I put the stones next to the walkway.'

b. A téglákat a sétány mellett helyezt-em el.
the brick.PL.ACC the walkway next.to place.PST-1SG.POSS aside
'I put the bricks next to the walkway.'

In being able to occur in count morphosyntax, *kő* ('stone') and *tégla* ('brick') display properties of count nouns, and in being able to refer to sums of entities when the argument of the definite article, these nouns display a property of mass nouns. In having both of these sets of properties, *kő* ('stone') and *tégla* ('brick') might be considered dual-life nouns.

6.2 Previous analyses of Hungarian

6.2.1 Number neutrality in Hungarian

Hungarian is often counted among general number or number neutral languages (e.g. Rullmann and You 2006; Espinal 2010), because of the evidence from Farkas and De Swart (2003), who state that Hungarian incorporated nominals are number neutral. The noun incorporation in question is that of nouns in the accusative case that are otherwise bare, which Farkas and De Swart (2003) claim involves Unification of thematic arguments. Unification involves the combination of two thematic arguments: one contributed by a nominal and one contributed by the main verb in a construction.

In their analysis of the semantics and pragmatics of plurals, however, Farkas and de Swart (2010) go a step further than they do in their 2003 analysis. Farkas and de Swart (2010) argue that Hungarian singular nouns are unmarked for number and therefore number neutral in many environments. Such environments include co-occurrence with determiners like *hàrom* ('three'), *sok* ('many'), *mindenféle* ('all kinds of'), *több* ('more'), and *egy pár* ('a couple of'/'some'). They argue that it is only through competition with plural-marked nouns that the singular is interpreted as exclusively atomic. For example, because the singular and plural can both occur with the definite article *a* ('the'), in this environment the singular gets exclusively atomic reference because the plural is specified as having plural reference while the singular is not.

Because the focus of Farkas and de Swart (2010) is the readings of singular and plural count nouns in Hungarian, they do not address mass nouns, classifier constructions, or pseudo-partitive DPs. Farkas and de Swart (2010) follow Rullmann and You (2006) in assuming that bare singular nouns in Hungarian are number neutral, using DPs with plural reference like those in (6.13) as evidence in support of this assumption. This assumption, however, presents the problem of accounting for sentences like (6.42), which

shows that plural nouns can have inclusive reference and therefore refer to a semi-lattice of individuals just like singular nouns. The problem that Farkas and de Swart (2010) set out to account for is why it would be the case that Hungarian has both number neutral bare (singular) count nouns and plural nouns with inclusive readings rather than plural nouns with strictly exclusive interpretation as in (6.43).

(6.42) Láttál valaha lovakat?
see.PST.2SG.INDEF ever horse.PL.ACC
'Have you ever seen horses?' (Farkas and de Swart 2010, p. 9)

(6.43) Mari látott lovakat.
Mari saw horse.PL.ACC
'Mari saw horses.' (Farkas and de Swart 2010, p. 9)

The analysis that Farkas and de Swart (2010) propose is that the plural is both morphologically and semantically marked as referring to sums, both inclusively and exclusively.

(6.44) a. $[\![Pl]\!] = \lambda x \lambda^* P[x \in SUM \cup ATOM \wedge {}^*P(x)]$
b. $[\![Pl]\!] = \lambda x \lambda^* P[x \in SUM \wedge {}^*P(x)]$ (Farkas and de Swart 2010, p. 23)

As seen in (6.44), the plural is marked such that it must include sums. The choice between whether a plural has inclusive or exclusive reference is driven by the Strongest Meaning Hypothesis for Plurals, which is based on the Strongest Meaning Hypothesis (Dalrymple et al. 1998; Winter 2001; Zwarts 2004). The Strongest Meaning Hypothesis for Plurals stipulates that, "for a sentence involving a plural nominal, prefer that interpretation of [Pl] which leads to the stronger overall interpretation for the sentence as a whole, unless this interpretation conflicts with the context of utterance" (Farkas and de Swart 2010, p. 28). The choice between the inclusive and exclusive reading, therefore, depends on the context: In a downward entailing context or a question, the plural is interpreted inclusively (6.42), while in an upward entailing context, the plural is interpreted exclusively (6.43).

While the inclusive plural is the same as the number neutral singular in respect to reference, there is an important difference between the two in respect to semantic and morphological markedness. As shown in (6.44), the plural is morphologically marked plural, indicating that it must include reference to sums, while the number neutral noun is not marked in this way. Because the bare singular includes sums by definition and isn't overtly marked as having them, the singular can occur in contexts where the noun's denotation is restricted to atomic reference (6.45).

(6.45) a. Mary saw a horse.
b. $\exists x : [x \in ATOM\& * HORSE(x)][SAW(m, x)]$

The number neutrality of the singular explains why it can occur with the determiners/quantifiers in (6.13), namely, because the determiners/quantifiers in question are able to access the relevant sums. Farkas and de Swart (2010) argue that plural is not used in this context because using the number-neutral singular is not only sufficient but also unmarked and therefore less complex. In English, the plural is used in this context because of a number agreement requirement.

In respect to (6.46) and (6.47) where we see the singular noun having singular atomic reference rather than plural reference, Farkas and de Swart (2010) argue that this occurs because of competition with the plural: Because nouns marked as plural can occur in these contexts as well, the singular is forced to have a exclusively atomic reference.

(6.46) Mari látott egy lovat.
Mari saw a horse.acc
'Mari saw a horse.' (Farkas and de Swart 2010, p. 9)

(6.47) A gyerek elment.
the child leave.past
'The child left.' (Farkas and de Swart 2010, p. 9)

Farkas and de Swart (2010) argue that advantages of this approach to number marking are that it aligns semantic and formal markedness, and it accounts for the use of singular nouns with number neutral reference. Semantic markedness is recognized as follows: i' is marked relative to i iff i' is associated with a semantic requirement that is lacking in i. Farkas and de Swart (2010) thus make the plural semantically marked relative to the singular because, while they both denote the upward closure of atoms via the sum operation *, the plural has the semantic requirement $x \in SUM$ that is lacking in singular nouns. It is in this way that the Hungarian plurals are semantically and formally marked relative to the singular. Because the singular is assumed to be number neutral, this account also accounts for the number neutral reference of singular forms.

6.2.2 Hungarian as a classifier language

The focus of Csirmaz and Dékány (2014) is the classifier system in Hungarian, and they do not address the readings of plurals, the determiner system, or pseduo-partitive DPs. Csirmaz and Dékány (2014) argue that Hungarian is a classifier language in the same

sense as languages like Mandarin and Japanese. In support of this argument, they note that there are several similarities between the classifier system in Hungarian and those of classifier languages like Mandarin and Japanese. The first similarity is that nouns can occur with different classifiers in both Hungarian, (6.27) and Cantonese. Second, Hungarian has a general classifier *darab*, which, like *ge* ($\text{CL}_{general}$), can be used instead of a more specific classifier, (6.23). Third, classifiers, as their name suggests, serve to classify the nouns they combine with according to a certain property, e.g. shape, (6.20). Fourth, and also exemplified by (6.20), nouns for the names of body parts and objects with canonical shapes are used as classifiers. Lastly, classifiers in Hungarian, like those in Thai can be used anaphorically, with the reference overtly or contextually specified, (6.29).

Csirmaz and Dékány (2014) assume that all nouns have an un-individuated denotation in Hungarian. Counting is assumed to occur only with individuated nouns, so no noun is countable. This assumption explains the presence of the classifier system in Hungarian: classifiers are required to individuate the denotation of the noun and permit counting. They assume that a morphologically null classifier is used when nouns directly combine with numericals. Despite the claim that all nouns are un-individuated (mass) in Hungarian, Csirmaz and Dékány (2014) seem to assume a mass/count distinction in Hungarian at least at a descriptive level, given they report that sortal and group classifiers can occur with count nouns while measure classifiers can occur with both count and mass nouns. However, Csirmaz and Dékány (2014) do not propose a theory of the mass/count distinction to which they subscribe, so it is unclear precisely what they mean by mass and count.

6.2.3 Hungarian as a 'mixed language'

Rothstein (2017) and Schvarcz and Rothstein (2017) argue that Hungarian has a 'mixed' nominal system in the sense that it has both a classifier system and a mass/count distinction. With respect to the Hungarian classifier system, they assume that all nouns that combine with a classifier have a mass denotation, thereby explaining why classifiers exist—i.e. they provide the information necessary for counting. With this position, the presence of the classifier system in Hungarian impacts the mass/count distinction in Hungarian in the sense that nouns that can directly combine with numericals—i.e. count nouns—must also have a mass denotation if they can also combine with a classifier. Rothstein (2017) and Schvarcz and Rothstein (2017) also assume the mass denotations of these nouns are required when these nouns occur in pseudo-partitive measure DPs, building on similar assumptions in Rothstein (2010). Because these nouns have both a count denotation and a mass denotation, they are dual-life nouns. This analysis results

in a distribution of nouns across countability classes only seen in one other language, Brazilian Portuguese (Pires de Oliveira and Rothstein 2011), which has also been argued to have many dual life nouns, many mass nouns, and very few count nouns.

The arguments in favor for the dual-life analysis rely on the claim that the nouns in question have a count denotation. This claim is supported by the assumption that these nouns can be directly modified by numericals and the assumption that such nouns each have a count denotation. These two assumptions lead to the conclusion that countable nouns have count denotations. Additionally, Rothstein (2017) and Schvarcz and Rothstein (2017) have two distinct arguments in support of their claim that the majority of countable nouns in Hungarian each have a mass denotation in addition to their respective count denotations—i.e. are dual life. The first argument is based on the existence of a classifier system in Hungarian, and the second argument is based on the fact that bare singular nouns are used in measure DPs.

The first argument that count nouns also have a mass denotation is based on the Hungarian classifier system and relies on the assumption that nouns are only felicitous with classifiers if they have a mass denotation. This assumption is argued for by both Chierchia (1998a) and Rothstein (2010), who assume that nouns with mass denotations are not countable because a set of countable atoms is not defined. Because most countable nouns occur felicitously with classifiers in Hungarian, (6.6), Rothstein (2017) and Schvarcz and Rothstein (2017) argue these nouns must have a mass denotation. Because these countable nouns have a mass denotation in addition to their count denotation, they are dual-life.

The second argument that the majority of countable nouns are dual life is based on the fact that these nouns occur in singular form in measure DPs, (6.11). This argument relies on the assumption that nouns occurring in measure DPs have a mass denotation. The assumption that only mass nouns occur in measure DPs is argued for by Rothstein (2011), with the assumption that (6.48) is infelicitous.

(6.48) #Twenty kilos of books are lying on top of each other on the floor. (Rothstein 2011, p. 24)

Rothstein (2011) concludes that (6.48) is infelicitous because the reciprocal operator *each other* cannot access atoms in the denotation of *books* in the measure DP. The idea is that, if *books* had a count denotation in (6.48), then the countable individuals it denotes should be accessible. However, the atoms are assumed to be inaccessible given Rothstein's felicity judgment, therefore *books* must be mass in the measure DP in (6.48). Rothstein (2017) and Schvarcz and Rothstein (2017) assume that the same is true of *könyv* ('book')

in Hungarian when it occurs in a measure DP and with the WH-quantifier *mennyi* ('what quantity of'). Rather than assuming that count nouns shift to a mass denotation before occurring in measure DPs, Rothstein (2017) and Schvarcz and Rothstein (2017) assume that *könyv* ('book') is ambiguous between a mass denotation and a count denotation, hence the analysis that most countable nouns are in fact dual-life.

The formal analysis provided by Rothstein (2017) and Schvarcz and Rothstein (2017) is built on the analysis of the mass/count distinction of Rothstein (2010).

6.2.3.1 Counting by indexing contexts: Rothstein (2010)

In analyzing the mass/count distinction, Rothstein (2010) distinguishes three types of atomicity: natural atomicity, formal atomicity, and semantic atomicity. Natural atomicity is determined by whether or not the entities denoted by a noun have inherently individuable units—i.e. are solid objects like *chairs* and *bicycles* rather than substances, liquids, or gases, like *mud*, *water*, or *fog* in the sense of Soja et al. (1991). Formal atomicity, on the other hand, is a property of the way the formal model is built: formal atoms are used to generate the Boolean algebra that is the nominal domain. Formal atoms are defined as not having any parts (6.49).

(6.49) $\forall x[AT(x) \longleftrightarrow \neg\exists y[y \sqsubset x]]$

Lastly, a semantic atom is an atom relative to a predicate—that is, an entity in the denotation of a predicate is an atom relative to that predicate, if it does not have any parts that are also in the denotation of the predicate (6.50).

(6.50) $\forall x[AT(P)(x) \longleftrightarrow \neg\exists y[P(x) \wedge P(y) \wedge y \sqsubset x]]$

For Rothstein (2010), natural atomicity accounts for cardinality judgments of object mass nouns like *furniture* in the quantity comparison tasks conducted by Barner and Snedeker (2005). Rothstein (2010) also shows that denoting natural atoms is not a necessary condition for being a count noun. This is seen in the example given in Rothstein (2011), in which fencing is erected to surround all four sides of a rectangular plot of land, it could be counted as one fence or as four fences. If counting were based on atomicity alone, then having these alternative ways of counting the same fencing should not be possible. Given denoting natural atoms is not a necessary or sufficient condition for being a count noun, another explanation must be sought.

The difference between natural atomicity and counting is at the center of Rothstein's (2010) analysis. Counting occurs when entities are put in one-to-one correspondence with natural numbers, and given object mass nouns exemplify the fact that natural atomicity is not a necessary or sufficient condition for being a count noun, Rothstein (2010) argues that the issue of what counts as one is contextually determined. Rothstein (2010) therefore assumes a set of counting contexts, K, which contains counting contexts, k. A counting context, k, is used to determine a set of countable atoms, A_k. The meaning of a singular count noun is derived by applying the operation $COUNT_k$ to a root noun, thereby selecting a set of countable individuals. For Rothstein (2010), a root noun denotes a Boolean algebra generated under sum from a set of atoms. Mass nouns are assumed to straightforwardly have root denotations, and in this sense they come into the lexicon with semantically plural reference, denoting atoms and sums thereof. In type-theoretic notation, mass nouns denote functions from entities to truth values, $\langle e, t\rangle$, and count nouns denote functions from entity-context pairs to truth values, $\langle e \times k, t\rangle$.

In respect to pluralization, Rothstein (2010) follows Link (1983) in using the * operation. Because of the unique approach to count nouns in Rothstein's (2010) analysis, however, * is not the plural operation itself. Instead, the plural operation, PL, gives the closure under sum of the atoms, d, denoted by a count noun, N_k, which accessed via the projection operation, π_1.

(6.51) $\quad PL([\![N_{count}]\!]) = {}^*N_k = \{\langle d,k\rangle\colon d \in {}^*\pi_1(N_k)\}$

Numerical expressions like *three* are type $\langle\langle d \times k, t\rangle, \langle d \times k, t\rangle\rangle$, thereby taking count noun denotations and returning count noun denotations, (6.52). For Rothstein (2010) counting occurs via a cardinality function $|\ \ |_k$, which counts the atomic parts in the counting context, k, accessed via $\pi_2(P)$. For *three*, $\pi_1(N_k)$ are sums of three atomic parts in k.

(6.52) $\quad [\![Three_{\langle\langle d\times k,\ t\rangle,\langle d\times k,\ t\rangle\rangle}]\!] = \lambda P \lambda x.P(x) \wedge |\ \pi_1(x)\ |_{\pi_2(P)} = 3$

'*Three* denotes a function which applies to a count predicate of type $\langle d \times k,\ t\rangle$ and gives the subset of the count predicate i.e. a set of ordered pairs where the first projection of each ordered pair has three parts which count as atoms in k.'

(Rothstein 2010, p. 377)

With respect to classifiers, Rothstein (2010) builds on the assumption of Krifka (1995) that the operation for counting is encoded in classifiers. Rothstein (2010) also follows Chierchia (1998a) in assuming that nouns in classifier languages have mass denotations that are made countable when counted with a classifier. The interpretation of a classifier

is given in (6.53), where classifiers modify root nouns, which are equivalent to mass nouns, and include additional information about the individuated unit via Q.

(6.53) $[\![\text{Classifier(N)}]\!] = \text{COUNT}_{\text{k}}(\text{N}_{\text{root}} \cap \text{Q})$ (Rothstein 2010, p. 388)

This is different from Krifka (1995), who assumes that classifiers combine with kind denoting nouns, rather than nouns that have been shifted to a mass denotation.

6.2.4 A disjointness-based approach to Hungarian: Erbach et al. (2019)

Erbach et al. (2019) argue that, under an alternative analysis of classifiers and a more mainstream analysis of measure DPs, the countability classes in Hungarian are much more similar to those in English than argued by Rothstein (2017) and Schvarcz and Rothstein (2017). Following the analysis of classifiers in Japanese argued for by Sudo (2016), classifiers modify both count and mass nominal predicates, Erbach et al. (2019) show that the existence of a classifier system in Hungarian does not require that all nouns have a mass denotation. Similarly, following the commonly assumed analysis of measure DPs, in which they require *cumulative* predicates to denote what is measured (i.a, Krifka 1989; Filip 1992, 2005; Nakanishi 2003; Schwarzschild 2006), it is not necessary to assume that all nouns must have a mass denotation to occur in measure DPs, contra Rothstein (2010, 2017) and Schvarcz and Rothstein (2017). In addition to arguing for these analyses of classifiers and measure DPs, Erbach et al. (2019) assume that Hungarian bare nouns are number neutral, thereby motivating their combinatorial behavior, being sanctioned in classifier constructions and measure DPs. These arguments lead to the conclusion that the Hungarian nominal system is not as different as that in other number marking languages.

The assumption that Hungarian nouns are number neutral, Erbach et al. (2019) argue, explains their behavior in a number of environments. First are those mentioned by Farkas and de Swart (2010), namely determiners that require plural reference, (6.13). Second, in the limited cases that bare nouns occur, being number neutral accounts for the fact that these nouns can refer to individuals and sums thereof as in (6.18). The same is true of bare singular nouns in the translative case (6.19). The assumption that bare nouns are number neutral rather than mass also accounts for the fact that nouns like *könyv* ('book') only get a singular reading when in the argument position, (6.30), rather than a mass reading which should also allow reference to sums of books. Lastly, being number neural also means that bare nouns are sanctioned in classifier phrases and measure DPs.

Erbach et al. (2019) build their analysis of Hungarian on Filip and Sutton (2017), in which nouns are tuples of the kind ⟨*extension, counting_base, precondition*⟩. The first projection, *extension*, is the extension of the predicate, and since singular nouns are number neutral, they contain the *-operation to close the entities denoted by the predicate under sum, 6.54–6.55. The second projection, *counting_base*, is the set of entities that count as one relative to a counting context. The counting base is measured for cardinality by classifiers and numerical modifiers. *Könyv* ('book') contains the individuation function, IND, in the first and second projection because it denotes objects and therefore can be individuated, and *kosz* ('dirt') lacks the individuation function because it denotes a substance. The third projection, *precondition*, contains preconditions and/or presuppositions, such as the criteria for counting supplied by classifiers.

(6.54) $$[\![könyv]\!]^{c_i} = \lambda x.\langle {}^*c_i(\mathbf{IND}(\text{BOOK}))(x),\ \lambda y.c_i(\mathbf{IND}(\text{BOOK}))(y),\ \phi\rangle$$

(6.55) $$[\![kosz]\!]^{c_i} = \lambda x.\langle {}^*c_0(\text{DIRT})(x),\ \lambda y.c_0(\text{DIRT})(y),\ \phi\rangle$$

Following Krifka (1995); Bale and Coon (2014) and Sudo (2016), who treat numericals as numeral denoting in Mandarin, Chol, and Japanese respectively, Hungarian numericals like *három* ('three') denote numerals, e.g. 3, and require modification in order to combine with nouns. Classifiers like *darab* can perform this modification, thereby accounting for their existence in Hungarian. Classifiers compose with numbers and are then able to compose with a context indexed noun.

(6.56) $$[\![darab]\!]^{c_i} = \lambda n.\lambda c.\lambda P.\lambda x.\ \left\langle \begin{array}{l} \pi_1(P(x)), \\ \mu_{card}(x, \lambda y.\pi_2(P(y)) = n, \\ \text{QUA}(\lambda y.\pi_2(P(y))) \wedge \forall z.(\lambda y.\pi_2(P(y)))(z) \wedge z \sqsubseteq x \rightarrow \text{SOLID}(z) \end{array} \right\rangle$$

The preconditions of the classifier *darab* include the requirement that the counting base of the noun counted is quantized and refers to individuals that are solid, thereby accounting for the intuition that pieces of mud or blood that are counted with *darab* (CL) must be hardened.

In order to account for direct numerical–noun constructions, Erbach et al. (2019) follow Filip and Sutton (2017) in assuming a morphologically null modification operation on numericals, which perform the same sort of operation as classifiers. Erbach et al. (2019) depart from Filip and Sutton (2017) by including in the modification operation the

necessary semantics to count kinds, rather than counting only individuals.

$$[\![három\ könyv]\!]^{c_i} = \text{MOD}([\![három]\!]^{c_i})([\![könyv]\!]^{c_i}) =$$

$$\lambda n.\lambda P.\begin{cases} \lambda x. & \left\langle \begin{array}{l} {}^*c_i(\mathbf{IND}(\text{BOOK}))(x), \\ \mu_{card}(x, \lambda y.c_i(\mathbf{IND}(\text{BOOK})(y)) = 3, \\ \text{QUA}(\lambda y.c_i(\mathbf{IND}(\text{BOOK}))(y)) \end{array} \right\rangle, \\ \\ \lambda k. & \left\langle \begin{array}{l} {}^*c_i(\mathbf{SK}(\mathbf{book})(k), \\ \mu_{card}(k, \lambda k'.c_i(\mathbf{SK}(\mathbf{book}) = n, \\ \text{QUA}_k(\lambda k'.c_i(\mathbf{SK}(\mathbf{book})(k')) \end{array} \right\rangle \end{cases} \tag{6.57}$$

This accounts for the fact that direct numerical–noun composition can be used to count kinds as in (6.58) as opposed to classifier constructions which are only used for counting individuals, (6.59).

(6.58) három sütemény
three cookie
'three (individual/kinds of) cakes/cookies.' (Erbach et al. 2019)

(6.59) három darab sütemény
three CL_{piece} cookie
'three (individual/*kinds of) cakes/cookies.'

This analysis of classifiers and counting constructions motivates the hypothesis that classifier constructions restrict what can be counted in a given context, rather than, for example adding information about the properties of the individual unit as proposed by Rothstein (2011).

Measure words like *kiló* ('kilo') function in a manner similar to that of classifier when they are used in pseduo-partitive DPs. The similarity is that they first compose with numeral denoting numericals before composing with a noun, and they likewise contain a precondition, though measure words require that the extension of the noun is non-quantized.

$$[\![\text{kiló}]\!] = \lambda n.\lambda P.\lambda x.\langle \pi_1(P(c_0)(x)),\ \mu_{kg}(x) = n,\ \neg\text{QUA}(\lambda y.\pi_1(P(c_0)(y)))\rangle \tag{6.60}$$

Because bare nouns in Hungarian are number neutral, their extension is indeed non-quantized and they are therefore acceptable in pseudo-partitive DPs.

With the assumption that bare nouns are number neutral in Hungarian, Erbach et al. (2019) account for why Hungarian nouns do not take plural morphology in counting

constructions and why bare nouns are acceptable in pseudo-partitive DPs. The Hungarian classifier system, on the other hand, is accounted for with the assumption that numericals denote numerals and therefore require modification in order to compose with nouns, and that classifiers provide semantic criteria for counting particular entities.

6.3 Discussion of previous analyses

As none of the aforementioned analyses of Hungarian address all of the data, this section will review each analysis in turn and consider possible extensions in order to account for the data reviewed in Section 6.1. In particular, if the data in Section 6.1 is assumed to be indicative of object mass nouns in Hungarian, then each of the aforementioned analyses would have to account for this new data. Because the analysis of Farkas and de Swart (2010) is limited to the readings of singular and plural count nouns, it is unclear how they might analyze mass nouns, classifier constructions, and pseudo-partitive DPs.

6.3.1 Csirmaz and Dékány (2014)

Mass/count properties like composition with *hány* ('how many') and plural morphology could be accounted for by assuming that the null classifier combines with 'count' nouns but not with 'mass' nouns. However, because all nouns are assumed to be un-individuated, and no analysis of the mass/count distinction is given, the basis on which this null classifier might be used is unclear. For example, the given analysis includes no means of accounting for why this null morpheme could not occur with *lőszer* ('ammunition'), *felszerelés* ('equipment'), and *csomagolás* ('packaging'), in other words, there is no explanation for why it might be the case that these nouns are mass. Furthermore, it would be unclear why the mass interpretation of 'count' nouns cannot be used in argument position, for example with the definite article. In sum, as argued by Schvarcz and Rothstein (2017), the assumption that all nouns are un-individuated in Hungarian is not straightforwardly compatible with other phenomena in the language, though it does provide a basis for the existence of the language's classifier system.

6.3.2 Rothstein (2017); Schvarcz and Rothstein (2017)

The analysis motivated by Rothstein (2017) and Schvarcz and Rothstein (2017), which builds on Rothstein (2010, 2011), accounts for why nouns like *könyv* ('book') can occur with classifiers and measure DPs, but it cannot account for why singular nouns are used in direct composition with numericals and determiners. Schvarcz and Rothstein (2017)

state that a discussion of singular nouns in these environments is beyond the scope of the current paper, but it is unclear how they might accommodate this data given the formal analysis they use.

For example, given the analysis of numerical expressions used for counting in (6.52), assuming the same is true for *három* ('three') in Hungarian, only plural nouns should be accepted given it must be the case that the members of $\pi_1(\mathrm{N_k})$ are sums of three atomic entities in k. Because the count interpretation of *könyv* ('book') is assumed to be strictly singular, denoting only atomic entities in k, there is no way in this system for nouns to by counted higher than *egy* ('one').

In order to account for why morphologically singular count nouns can be counted with numericals higher than one, Rothstein (2017) and Schvarcz and Rothstein (2017) could assume that the count denotation *könyv* ('book') is number neutral rather than strictly singular, as is done by others. This assumption might also require a different analysis of plural morphology in Hungarian, given the one currently assumed for English by (Rothstein 2010, 2017), in which the plural is the closure under sum, would be entirely semantically redundant on singular nouns. Rothstein (2017) and Schvarcz and Rothstein (2017) might follow Farkas and de Swart (2010) in using the strongest meaning hypothesis for plurals to account for the different readings of singular and plural count nouns in Hungarian. Number neutral count nouns, in an analysis based on Rothstein (2010), are different from the object mass denotations that Rothstein (2017) and Schvarcz and Rothstein (2017) assume that nouns like *könyv* ('book') also have, the difference being that, while both refer to a semi-lattice of natural atoms, only the count denotation is indexed to a counting context k.

As seen in Section 6.1, Hungarian has at least three object denoting nouns that cannot felicitously combine with numericals or the count WH-quantifier *hány* ('how many'). Assuming these three nouns are object mass nouns, they would be type $\langle \mathrm{e,t} \rangle$ under the analysis of Rothstein (2017) and Schvarcz and Rothstein (2017) explaining why they cannot be modified by numerical expressions which only compose with count nouns, which are type $\langle \mathrm{e{\times}k,t} \rangle$. Though they do not propose an explicit formal analysis of *hány* ('how many'), it too could be restricted to being a modify of nouns that are type $\langle \mathrm{e{\times}k,t} \rangle$.

While the behavior of object mass nouns in Hungarian can easily be accommodated with respect to counting-specific morphosyntax under the analysis of Rothstein (2017) and Schvarcz and Rothstein (2017), it is unclear how they might account for the lack of definite mass readings of nouns like *könyv*, which they argue are dual-life nouns. Sticking to the dual-life analysis, Rothstein (2017) and Schvarcz and Rothstein (2017) would have to somehow distinguish between the object mass interpretation of dual-life nouns like *könyv* ('book') and the interpretation of nouns like *löszer* ('ammunition') and *kő*

('stone), which are assumed to be only object mass and dual life respectively. One way to make this distinction would be to assume that the object mass reading of nouns like *könyv* ('book') is only available in certain environments as the result of type shifting (see Rothstein 2011). With this approach, *könyv* ('book') is lexicalized as a count noun, and it is really only dual-life in this sense that it *can* be shifted to a mass interpretation in order to occur in measure DPs and with classifiers.

A last remark about the analysis of Rothstein (2010) noted by Sutton and Filip (2016b): the assumption that the difference between count nouns and mass nouns is a matter of indexing to a counting context k has no explanatory power beyond explaining how it is that the same set of entities could be counted in different ways. Under Rothstein's (2010), any noun could potentially be a count noun or a mass noun so long as there is a set of atomic entities in K and the noun undergoes the count operation. This characteristic does not reflect the crosslinguistic tendency for languages to have a set of count nouns that strongly correlates with the set of inherently individuable objects, and a set of mass nouns that strongly correlates with the set of substances, liquids, and gasses. While this analysis of object mass nouns can nevertheless be upheld for Hungarian, the assumption that the majority of countable nouns also have an object mass denotation is not straightforwardly compatible with the available data.

6.3.3 Erbach et al. (2019)

The analysis argued for by Erbach et al. (2019) accounts for the majority of the data discussed here, though analyses of object mass nouns, plural morphology, and determiners, for example, warrants further review. While object mass nouns in Hungarian are not explicitly analyzed by Erbach et al. (2019), the analyses on which they build, namely those of Sutton and Filip (2016b) and Filip and Sutton (2017), include analyses of object mass nouns in English and other number marking languages, and this analysis can be straightforwardly applied to the object mass nouns in Hungarian. For example, in the account of Sutton and Filip (2016b), *kitchenware* is mass because it is interpreted relative to the the null counting scheme, c_0, which includes overlapping individuals like pans, lids, and pan⊔lid sums. The same could be said of *lőszer* ('ammunition'), whose null counting scheme might include individuals like bullets and bullet⊔clip sums, and therefore does not have the requisite quantized counting base required by numerical modifiers.

Erbach et al. (2019) remain agnostic with respect to the analysis of plural morphology in Hungarian, and they do not specify exactly why it should be the case that singular count nouns can only refer to individuals and not sums thereof when composed with the definite article. A simple means of accounting for both of these characteristics of Hungarian

would be to analysis of plurality like that argued for by Farkas and de Swart (2010), wherein the Strongest Meaning Hypothesis for Plurals gives rise to the inclusive and exclusive readings of plural count nouns, and the singular readings of definite singular count nouns. Alternatively, a scalar implicature based analysis of plurals (Spector 2007) or QUD a measurement based analysis of plurals (Grimm 2013) might be motivated for Hungarian as has been done for English and is also discussed with respect to Greek in Chapter 5 of this thesis.

Erbach et al. (2019) do not predict the fact that classifiers occur between determiners and nouns. In fact, given their analysis assumes that classifiers compose with numeral denoting numericals, there is also no means of accounting for the co-occurrence of determiners, classifiers, and nouns. It cannot be possible that a morphologically null numeral 1 composes with the classifier before the classifier and noun compose with the determiner, because this would predict that bare classifier-noun constructions should occur, which Csirmaz and Dékány (2014) have argued is not the case based on data like (6.28-d). Given Erbach et al. (2019) propose that classifiers serve as a means of restricting the set of what can be counted, a modified version of their account might propose that classifiers are not required to turn numericals in modifiers, rather the classifier only contributes the selectional restrictions. These same, optional, selectional restrictions could also be contributed to determiners, thereby explaining why classifiers occur between determiners and nouns in the absence of numericals.

6.4 Implications from the discussion of Hungarian

This chapter has reviewed analyses of the Hungarian nominal system that make very different claims about the nature of object mass nouns in Hungarian. Csirmaz and Dékány (2014) have argued that all object denoting nouns in Hungarian are un-individuated (object mass nouns), and Rothstein (2017) and Schvarcz and Rothstein (2017) have argued that almost all nouns that refer to objects have an object mass denotation in addition to a count denotation. Quite differently, Erbach et al. (2019) have argued that it is not the case that (almost) all object denoting nouns are object mass in Hungarian, rather they present evidence that suggests only a few nouns are object mass in Hungarian, and this thesis has provided additional data in support of such a claim. The evidence in support of the claim that Hungarian has object mass nouns has shown that it is not the case that object mass denotations of countable nouns are required for composition in measure DPs. In other words while object mass nouns can occur in pseudo-partitive (measure) DPs, they are not the only object denoting nouns compatible in this environment, rather number-neutral and plural count nouns are felicitous as well. Furthermore, the analysis

of Erbach et al. (2019) results in a distributions of nouns across countability classes in which Hungarian has large classes of count nouns and mass nouns, and a relatively small class of object mass nouns falls in line with the typological predictions of Barner and Snedeker (2005) and Landman (2011) discussed in Chapter 3.

While Hungarian may be closely aligned with English in respect to the distribution of nouns across countability classes and the existence of count morphosyntax, there are a few crucial differences between the two languages with respect to their mass/count properties. First is that English seems to have a much more robust set of determiners that are specific to either mass nouns or count nouns than Hungarian does. There has, as of yet, been no evidence of a Hungarian determiner that is specific only to mass nouns for example. Furthermore, the fact that bare singular count nouns can occur and the existence of a classifier system make Hungarian align with classifier languages in some respects as well. Crucially, however, the facts that bare singular nouns cannot freely occur and that classifiers are optional for count nouns means that Hungarian is still quite different from classifier languages with respect to these two characteristics. While Rothstein (2017) and Schvarcz and Rothstein (2017) characterize Hungarian as a 'mixed' language having characteristics of both number marking and classifier languages, it might be more useful to characterize Hungarian as somewhere between English and Mandarin, for example, on a continuum between the two since Hungarian does not have all characteristics of both languages, rather it has more limited realizations of characteristics of both languages.

With respect to the main hypothesis of this thesis, namely that the presence of object mass nouns in a language is related to the number of morphosyntactic environments sensitive to the mass/count properties of nouns in that language, the evidence from Hungarian provides additional support. The number of presumed object mass nouns in Hungarian is relatively small, three, and so is the number of morphosyntactic environments known to be sensitive to the mass/count properties of nouns in Hungarian, four. The nouns presumed to be object mass are , and the morphosyntactic environments sensitive to the mass/count properties of nouns are plural morphology, direct counting, the count WH-determiner *hány* ('how many'), and *egy pár* ('a couple of'). Comparing Hungarian to English, which has many more object mass nouns and morphosyntactic environments sensitive to the mass/count properties of nouns, there is additional support for the hypothesis that the presence of object mass nouns in a language is related to the number of morphosyntactic environments sensitive to the mass/count properties of nouns in that language.

Chapter 7

Japanese

Japanese is a classifier language, meaning classifiers are obligatory in counting constructions, as exemplified in (7.1), where the classifier *rin* must be present in order for the construction to be grammatical.

(7.1) ichi-*(rin)-no hana
one-CL-GEN flower
'one flower' (Sudo 2016, p. 2)

While number marking languages like English show a contrast in the morphosyntax of counting constructions between count nouns and mass nouns, all nouns in classifier languages are counted with the same morphosyntax, as the data in (7.2) and (7.3) show is the case in the classifier language Mandarin.

(7.2) a. san *(ge) nanhai (Mandarin)
three $\text{CL}_{general}$ boy
'three boys'

b. yi *(ben) shu
one CL_{volume} book
'one book' (Chierchia 2010, p. 107)

(7.3) san ge xie (Mandarin)
three $\text{CL}_{general}$ blood
'three bags of blood' (Chierchia 2015, p. 20)

While nouns like *boy* and *book* can be directly counted—i.e. compose directly with a numerical—in English, nouns cannot be directly counted in classifier languages, that is, they require a classifier such as *ge* ($\text{CL}_{general}$) or *ben* (CL_{volume}) in (7.2) and (7.3)

respectively. These examples also show object denoting nouns like *nanhai* ('boy') and *shu* ('book') being counted in the exact same manner as substance denoting nouns like *xie* ('blood'). Such uniformity in counting constructions in classifier languages have led to analysis in which all nouns are taken to be of the same semantic type in such languages (e.g. Chierchia 1998a, 2010, 2015; Muromatsu 2003; Nemoto 2005; Li 2011; Rothstein 2017).

A corollary to the uniform treatment of nouns in classifier languages is the argument that classifier languages have no object mass nouns (Chierchia 2010). In Chapter 5, it was shown that Chierchia's (2010; 2015) analysis of object mass nouns ties the existence of object mass nouns to obligatory number marking languages like English, where singular morphology requires nouns to denote stable atoms, thereby driving a type-shifting operation whereby nouns denoting a join semi-lattice of unstable atoms are shifted to a singleton property, denoting the supremum of a join semi-lattice of unstable atoms. In Chierchia's (2010; 2015) analysis, object mass nouns arise when lexical choice allows them to shift to denoting a singleton property in the same way that occurs for nouns that denote unstable atoms. Because classifier languages like Mandarin lack obligatory number marking, Chierchia (2010) argues, they do not have the requirement that nouns denote atoms, and they will therefore not have object mass nouns:

> If a language lacks obligatory number marking, there is no need to turn its mass nouns into singleton properties. And hence, no copy cat effect can take place. As we will see shortly, classifier languages might indeed be a case in point"
>
> (Chierchia 2010, p. 139)

Given the analysis of Chierchia (2010, 2015) it should not be the case that any grammatical reflexes of object mass nouns can be observed in classifier languages.

Despite the widespread notion that nouns in classifier languages are of the same semantic type, recent work has shown that classifier languages display some of the characteristic properties of languages with a grammaticized lexical mass/count distinction. Inagaki and Barner (2009), for example, have shown that countable individuals are accessible when Japanese nouns are used in quantity comparisons without classifiers, suggesting that classifiers are not required for individuating entities denoted by Japanese nouns. Doetjes (2012) argues that the characteristics of the classifier system in Mandarin is evidence in favor of there being a lexical mass/count distinction in the language. Sudo (2016, 2015) has shown that there are several morphosyntactic environments that distinguish count nouns and mass nouns without the aid of classifiers in Japanese, again suggesting that classifiers are not required for individuating entities denoted by Japanese nouns. These

studies stand in sharp contrast to previous arguments made about the nature of the nominal domain in classifier languages, and they illustrate the need for further work on the nominal semantics of such languages.

These studies have served as inspiration for recent collaborative work on Japanese, (e.g. Erbach et al. 2017) in which the presence of object mass nouns in Japanese was the focus of empirical investigation. This line of investigation builds on the evidence from Sudo (2015) that there are quantifiers in Japanese that are sensitive to the inherent countability properties of nouns. For example, *nan-byaku-to-iu* ('hundreds of') is felicitous with nouns like *onna no hito* 'woman' and *isu* ('chair'), and infelicitous with nouns like *yuki* ('snow'). Initial results suggest that *nan-byaku-to-iu* ('hundreds of') is also infelicitous with *chōri-kigu* ('kitchenware'), which denotes sets of individuated objects, and therefore, could be assumed to have properties akin to object mass nouns like *kitchenware* in English. Crucially, constructions with *nan-byaku-to-iu* ('hundreds of') do not require a classifier (Sudo 2015), so it cannot be the case that countable individuals can only be accessed by classifiers, rather, there must be other means of doing so. The resulting proposal is that Japanese has at least some reflexes of a grammaticized lexical mass/count distinction, as evidenced by nouns that exhibit properties of object mass nouns.

In this chapter, I will review key examples of the analyses arguing that all nouns in classifier languages are of the same semantic type. I will then review contrasting work showing that classifier languages display some grammatical reflexes exemplary of a grammaticized lexical mass noun distinction, including my recent work on Japanese which tentatively suggests that certain Japanese nouns exhibit the characteristic properties of object mass nouns. The discussion of this data and analyses of the nominal semantics in classifiers will lead to the conclusion that nominal predicates in classifier languages can be treated on the same semantic basis as those in languages like English.

7.1 Classifiers in Mandarin

Several analyses of the mass/count distinction that address classifier languages use Mandarin to exemplify this class of languages (e.g. Krifka 1995; Chierchia 1998a, 2010, 2015; Barner and Snedeker 2005; Rothstein 2010, 2017; Landman 2011; Sutton and Filip 2016d). In light of this trend, this section will review relevant data on classifiers in Mandarin.

Cheng and Sybesma (1998, 1999) present the distinction between 'individual' and 'non-individual' classifiers as a manifestation of the mass/count distinction, though not at the level of the nouns. Individual classifiers are those that occur with nouns that are

assumed to "present themselves in discrete units" (Cheng and Sybesma 1998, p. 4). Non-individual classifiers are those that can occur with nouns, whether or not they present themselves in discrete units.

Cheng and Sybesma (1999, 1998) present two morphosyntactic contexts in which the use of individual and non-individual classifiers differs as evidence for the distinction between the two. First, as noted by Chao (1968), the modifier *de* can optionally appear between 'non-individual' classifiers and a noun, but it may not occur between 'individual' classifiers and a noun:

(7.4) san bang (de) rou
Three CL$_{pound}$ DE meat
'three pounds of meat' (Cheng and Sybesma 1999, p. 515)

(7.5) ba tou (*de) niu
eight CL$_{head}$ DE cow
'eight cows' (Cheng and Sybesma 1999, p. 516)

Cheng and Sybesma (1998) argue that non-individual classifiers, or 'massifiers', create a measure for counting, while count-classifiers simply name the unit in which the entity denoted by the noun it precedes naturally presents itself.

Li (2011) presents evidence for an even more fine distinction between sorts of classifiers than that proposed by Cheng and Sybesma (1998, 1999). Rather than an individual/non-individual distinction, Li (2011) argues for four categories of classifiers based on two features: [±C(ounting)] and [±M(easuring)]. Classifiers that are [-C,-M] are those that are used for counting kinds. Classifiers that are [+C,-M] include *ge* (CL$_{general}$), *zhi* (CL$_{animal}$), and *duo* (CL$_{blossom}$), (7.6-b), and are used in counting nouns that denote naturally discrete entities. Importantly, these naturally discrete entities need not be naturally atomic in the sense of Rothstein (2010), rather this class of entities includes clouds as in (7.6-a).

(7.6) a. yi duo yun
one CL$_{blossom}$ cloud
'a blossom of cloud'

b. yi duo mogu
one CL$_{blossom}$ mushroom
'a blossom of mushroom' (Li 2011, p. 122)

These classifiers are assumed to specify the counting unit intrinsic to the entities referred to by the noun that the classifiers are used with. Classifiers that are [-C,+M] include *bang*

(CL*pound*), (7.7), and other 'pure measure words' that measure entities along a certain dimension.

(7.7) liang bang tang
two CL*pound* sugar
'two pounds of sugar' (Li 2011, p. 126)

Classifiers that are [+C,+M] include 'group' classifiers like *qun* (CL*group*), 'partition' classifiers like *kuai* (CLpiece), and 'container' classifiers like *ping* (CL*bottle*), (7.8). These are argued to have two distinct uses: one is to refer to a particular entity and the other is to refer to a particular measurement. For (7.8), the entity reading is such that the speaker drank wine out of a particular bottle, while the measurement reading is that an entire bottle's worth of wine (e.g. 750ml) was consumed by the speaker.

(7.8) wo he le yi ping hongjiu
I drink PERF one CL*bottle* red.wine
'I drank a bottle of wine.' (Li 2011, p. 128)

The evidence in support of a class of [+C,+M] classifiers, and the distinction between uses of *ping* (CL*bottle*) is the same test for individual classifiers and non-individual classifiers used by Cheng and Sybesma (1998, 1999), namely whether the modifier *de* can be placed in between the classifier and the noun. Li (2011) provides the examples in (7.9), in support of this claim.

(7.9) a. *wo kai le san ping de jiu.
I open PERF three CL*bottle* DE wine
Intended: 'I opened three bottles of wine.' [Counting]

b. wo-de wei neng zhuangxia san ping de jiu.
my stomach can hold three CL*bottle* DE wine
'My stomach can hold three bottles of wine.' [Measure]

(Li 2011, p. 189)

As shown by Cheng and Sybesma (1998, 1999), the modifier *de* is not grammatical when placed between and individual classifier and a noun, (7.5), but it is grammatical when placed between a non-individual classifier and a noun, (7.4). The sentences in (7.9) replicate this pattern, where the modifier *de* cannot occur between a noun and *ping* (CL*bottle*) when the classifier gets an individual interpretation, (7.9-a), but the modifier can occur between a noun and the classifier when the classifier has a measure interpretation, (7.9-b).

In addition to arguing for a finer distinction in the analysis of Mandarin classifiers, Li (2011) shows that classifiers in Mandarin are not only used in counting constructions like those above, rather they are also required with two determiners (7.10), optional with three determiners (7.11), and ungrammatical with two determiners (7.12).

(7.10) a. mei *(ge) xuesheng
every CL student
'every student'

b. ji *(ge) xuesheng
several CL student
'several students' (Li 2011, p. 6)

(7.11) a. zhe (ge) xuesheng
this CL student
'this student'

b. xuduo (ge) xuesheng
many CL student
'many students'

c. yikie (ge) xuesheng
some CL student
'some students' (Li 2011, p. 6)

(7.12) a. daduoshu (*ge) xuesheng
most CL student
'most students'

b. suoyou (*ge) xuesheng
all CL student
'all students' (Li 2011, p. 7)

7.2 Previous analyses of classifier languages

A widely argued for analysis of classifier languages is that all nouns in these languages are of the same semantic type. Chierchia (1998a); Cheng and Sybesma (1998, 1999); Nemoto (2005); Landman (2011); Li (2011) and Rothstein (2017), for example, have all argued that all nouns in classifier languages are mass, and that classifiers, in one way or another, make these mass nouns countable in a manner similar to the way *pieces of* is used for counting *furniture* in English. At the same time, Krifka (1995); Chierchia (1998a, 2010, 2015) and Rothstein (2017) have argued that all bare nouns are kind denoting in such languages. A related view is that of Muromatsu (2003), who argues that all bare nouns have the same sort of quality denoting internal structure. These analyses of nouns in classifier languages stand in sharp contrast to the analysis of nouns in languages like

English discussed in Chapter 3, where count nouns and mass nouns have semantically distinct denotations. This section will review some of the most widely cited analyses of classifier languages.

7.2.1 A classifier based distinction

7.2.1.1 Chierchia (1998a)

Following Krifka (1995), Chierchia (1998a) assumes that Mandarin nouns are the names of kinds rather than predicates. Chierchia (1998a) also assumes a type-shifting operation π that changes the kind denotation from the maximal element of the semilattice denoted by the noun to the full semi-lattice. In this way, all Mandarin nominal predicates are mass. Differently from Krifka (1995), who assumes that classifiers combine with numericals, Chierchia (1998a) assumes that classifiers combine with nouns in order to make the nouns countable predicates that are free to combine with numericals. This series of operations is exemplified in (7.13).

(7.13) liǎng zhāng zhuōozi (Chinese)
two CL table
'two tables'
liǎng(zhāng(π(zhuōzi))) (Chierchia 1998a, pp. 92-3)

Chierchia's (1998a) analysis of counting in Mandarin parallels his analysis of counting portions of a substance with 'classifiers' in English. So, while English has two ways of counting, Mandarin has eliminated this redundancy.

Chierchia (1998a) shows that encoding all nouns as mass, as in Mandarin, has several consequences for such languages. First, because all nouns are semantically mass, thereby denoting a semi-lattice, they are semantically plural and there is essentially no need for a pluralization operation in Mandarin, like that which is encoded in plural morphology in English. Secondly, there is likewise no need for an indefinite article, since it is assumed to be a variant of the numerical *one*. Similarly, there is no need for a definite article, because nouns already stand in one-to-one correspondence with the maximal elements of the semi-lattices they denote. Each of these predictions are seen to be the case in Mandarin.

While this system looks like it would have no mass/count distinction, Chierchia (1998a) argues there is still room for such a distinction at a phrasal level. This distinction can exist because of the fact that liquids and solids come from different natural classes, which classifiers, for example, can be sensitive to. In other words, while all nouns are mass in

the sense that they all denote semi-lattices, classifiers might yet be sensitive to whether the entities that comprise the lattices are objects or substances.

This approach to classifier languages is assumed by Landman (2011), even though he takes a very different approach to the analysis of the mass/count distinction in number marking languages than that of Chierchia (1998a). Recall that, for Landman (2011), the denotation of a plural count noun has the structure $\langle {}^{*}\mathrm{N}_w, \mathrm{N}_w \rangle$, where the second projection specifies the countable individuals in N_w, that is, the minimal elements of the generating set of N_w. For Landman (2011), all nouns in classifier languages have denotations of the form $\langle {}^{*}\mathrm{N}_w, {}^{*}\mathrm{N}_w \rangle$, meaning that both the intension and the generating set for the noun are closed under sum and cannot be counted without access to the minimal elements of the generating set. Classifiers, therefore, provide the means of accessing the minimal elements of the generating set of a noun so that counting can occur.

7.2.1.2 Chierchia (2010)

Chierchia (2010) largely maintains his analysis of classifier languages from 1998a, despite the fact that that he drastically changes his analysis of number marking languages, as described in Chapter 5. Couched in a type-theoretic framework, kind denoting nouns of type k require a classifier of type $\langle k, \langle e, t \rangle \rangle$ in order to combine with numerical expressions, which Chierchia (2010) assumes are universally of the adjectival type $\langle \langle e, t \rangle, \langle e, t \rangle \rangle$. Chierchia (2010) also modifies his account of the distribution of classifiers in Mandarin. While the previous account (Chierchia 1998a) assumed that classifiers in Mandarin can be sensitive to the natural classes solid and liquid, Chierchia (2010) shifts this sensitivity to the distinction kinds that are atomic and those that mass, presumably referring to the kind interpretation of nouns that denote stable atoms versus the kind interpretation of nouns that denote unstable atoms.

To the list of predictions such an approach makes, Chierchia (2010) adds the following. First, bare arguments should freely occur because nouns are kind denoting and they can freely merge with verbs via syntactic combination if the result is semantically coherent. Secondly, because classifier languages lack obligatory number marking, there is no requirement to turn mass nouns into singleton properties as is required by the definition of singular nouns, namely that they denote stable atoms. While lexical choice and this requirement to denote stable atoms results in object mass nouns in English—i.e. nouns denoting stable atoms copy mass nouns in denoting singleton properties—the lack of such a requirement in classifier languages leads Chierchia (2010) to the conclusion that classifier languages cannot have object mass nouns. This prediction that classifier languages have

no object mass nouns further solidifies a stance in which any sort of mass/count distinction in classifier languages should fall directly in line with the substance/object distinction.

7.2.1.3 Chierchia (2015)

Chierchia (2015) explicitly defines classifier languages as "those in which no noun can directly combine with a numerical" (Chierchia 2015, p. 165). He argues that such languages have a grammatical mass/count distinction that primarily is manifested in the classifier system along the lines described by Cheng and Sybesma (1998, 1999). He also argues that it is wrong to claim that all nouns are literally mass in classifier languages and consequently that such languages have no mass/count distinction. While stating it is wrong to consider all nouns to be mass in classifier languages contradicts the analysis in Chierchia (1998a), assuming there is a mass/count distinction in the classifier system is essentially what he has made room for in all of his analyses.

Chierchia (2015) discusses two types of classifiers with different distributions, 'individual' classifiers and 'measure' classifiers. Individual classifiers, like *ge* ($\text{CL}_{\text{general}}$) and *ben* ($\text{CL}_{\text{volume}}$), are only used with kinds of objects that come in natural units. Measure classifiers, like *mi* ('meter') on the other hand, can occur with both object and substance denoting nouns. The realization of the selection bias of individual classifiers is formalized with the AT operation in the denotation of individual classifiers like *zhi*, (7.14-a), which composes with *mao* ('cat'), (7.14-b), and is therefore able to be modified by a numerical, (7.14-c).

(7.14) a. zhi→ $\lambda k \lambda n \lambda x[n(\text{AT}(^{\cup}k))_w(x)]$
b. zhi mao→ $\lambda n \lambda x[n(\text{AT}(^{\cup}c))_w(x)]$
c. san zhi mao→ $\lambda x[\text{three}(\text{AT}(^{\cup}c))_w(x)]$ (Chierchia 2015, p. 167)

This account maintains the prediction in Chierchia (1998a, 2010) that the existence of a classifier system is triggered by the fact that nouns and numericals cannot combine otherwise.

7.2.2 A different sort of countability distinction: Rothstein (2010, 2017)

Rothstein (2010, 2017) largely follows the analysis of classifier languages in Chierchia (1998a) assuming that all nouns in classifier languages denote kinds and when shifted to predicates are mass. However, given Rothstein (2010, 2017) argues for a different analysis

of the mass/count distinction than that of Chierchia (1998a) (for details, see Chapter 6), her analysis of precisely how classifiers function differs as well. Furthermore, while Chierchia (1998a, 2010, 2015) leaves open the possibility that a mass/count distinction exists in classifier languages at the phrasal level, and argues it is directly visible in the distribution of individual classifiers, Rothstein (2017) explicitly argues that there is not a grammatical mass/count distinction in the distribution of individual classifiers, rather the only mass/count distinction in classifier languages is the distinction between not-countable nominal predicates, type $\langle e, t\rangle$, and countable nominal predicates, type $\langle e \times k, t\rangle$.

As in Rothstein's (2010; 2017) analysis of counting in number marking languages, counting can occur when the entities in the denotation of a noun are indexed to a counting context, k. Given all nouns in Mandarin are assumed to denote kinds and therefore be of type Σ, classifiers used for counting discrete individuals do so by mapping kinds onto predicates that are indexed to a counting context—i.e. they are of type $\langle \Sigma, \langle \mathrm{e} \times \mathrm{k}, \mathrm{t}\rangle\rangle$. Classifier + noun compositions pick out discrete individuals in a context k that are countable as illustrated in (7.15).

(7.15) Let a, x be variables of type e×k, k a context.
We define: $\mathbf{a} \sqsubseteq_{\mathrm{k}} \mathbf{x}$ iff $\pi_1(\mathbf{a}) \in \mathrm{k}$ and $\pi_1(\mathbf{a}) \sqsubseteq \pi_1(\mathbf{x})$ and $\pi_2(\mathbf{a}) = \pi_2(\mathbf{x}) = \mathrm{k}$

a. *gè*: $\lambda\Sigma\lambda\mathbf{x}.\pi_1(\mathbf{x}) \in {}^{\cup}\Sigma \cap \mathrm{k} \wedge \pi_2(\mathbf{x}) = \mathrm{k}$

b. *gè rén*: $\lambda\mathbf{x}.\pi_1(\mathbf{x}) \in {}^{\cup}\mathrm{PEOPLE}_{\Sigma} \cap \mathrm{k} \wedge \pi_2(\mathbf{x}) = \mathrm{k}$

c. *sān gè rén*: $\lambda\mathbf{x}.\forall\mathbf{a}[\mathbf{a} \sqsubseteq_{\mathrm{k}} \mathbf{x} \rightarrow \pi_1(\mathbf{a}) \in {}^{\cup}\mathrm{PEOPLE}_{\Sigma} \cap \mathrm{k}] \wedge \pi_2(\mathbf{x})_{\mathrm{k}} = 3$

(Rothstein 2017, p. 160)

Following Li (2011), Rothstein (2017) assumes that classifiers like *píng* (CL_{bottle}) are both individual classifiers and measure (non-individual) classifiers. As an individual classifier, *ping* (CL_{bottle}) is very much like *ge* ($\mathrm{CL}_{general}$), albeit it specifies that the noun it composes with is contained in bottles that are indexed to a counting context.

(7.16) *píng*: $\lambda\Sigma\lambda\mathbf{x}.\pi_1(\mathbf{x}) \in \mathrm{BOTTLE}\cup\mathrm{k}\wedge\pi_2(\mathbf{x}) = k\wedge\exists\mathrm{y}[\mathrm{y} \in {}^{\cup}\Sigma\wedge\mathrm{CONTAIN}(\pi_1(\mathbf{x}), \mathrm{y})]$

(Rothstein 2017, p. 161)

Rothstein (2017) argues that the measure reading of *píng* (CL_{bottle}), is type $\langle \mathrm{n}, \langle \mathrm{e},\mathrm{t}\rangle\rangle$, and therefore able to combine with a numerical then shift to a predicate modifier, type $\langle\langle \mathrm{e},\mathrm{t}\rangle, \langle \mathrm{e},\mathrm{t}\rangle\rangle$.

(7.17) *píng*: $\lambda\mathrm{n}\lambda\mathrm{x}.\mathrm{MEASURE}_{\mathrm{VOLUME,BOTTLE}}(\mathrm{x}) = \mathrm{n}$

Rothstein (2017) argues that classifiers like *píng* (CL_{bottle}), which are assumed to be both individual and non-individual classifiers, prevent a bipartite division between types of classifiers—i.e. not all classifiers can strictly categorized in only one group. More importantly the classifiers that can be called individual classifiers do not form a unified group: the morphosyntactic behavior of strictly individual classifiers like *ge* ($\text{CL}_{general}$) in (7.15) cannot be distinguished from the behavior of the individual interpretation of classifiers like *píng* (CL_{bottle}), which is semantically distinct. For Rothstein (2017), it is this heterogeneity among classifier+NP constructions that can be called 'individual' that prevents these constructions from being called 'count', and she therefore claims that Mandarin has no mass/count distinction at the classifier level.

7.3 Mass/count reflexes in classifier languages

7.3.1 Individuation without classifiers: Inagaki and Barner (2009)

Inagaki and Barner (2009) use quantity comparison tasks to demonstrate differences in individuation/atomicity between mass and count nouns in Japanese, English, and French. Presenting participants in the study with pictures similar to those in Figure 7.1, Inagaki and Barner (2009) sought to determine whether participants would compare quantities of a particular entity in terms of cardinality or volume/area.

FIGURE 7.1: Quantity Comparison in the Style of Inagaki and Barner (2009)

Participants were asked to conduct a quantity comparison with questions like (7.18), which contain no classifier or other grammatical means of specifying that there might be individuals to count.

(7.18) Dotira-no hito-ga yori-ookuno hoorensoo-o motte-iru
which-GEN person-NOM more.than-more spinach-ACC have-PROG
desyoo
COP.QCOP.Q
'Who has more spinach?' (Inagaki and Barner 2009, p. 125)

Both English and Japanese speakers favored cardinality comparisons for count nouns like *kutu* ('shoe') and artifactual aggregate nouns like *kagu* ('furniture'), they favored volume comparisons for substance nouns like *karasi* ('mustard'), and they used both volume and cardinality comparisons for dual life nouns. One way that English and Japanese speakers differed was in judgments of *hoorensoo* ('spinach'): English speakers favored volume judgments, while Japanese speakers favored cardinality judgments, as did French speakers for whom *d'epinards* ('spinach') is a count noun. Inagaki and Barner (2009) argue that these results show that individuation can be encoded in nouns whether or not a language has mass/count syntax. Furthermore, they suggest that count syntax is not necessary for nouns to specify individuation.

7.3.2 Arguments for nominal individuation: Doetjes (2012)

Doetjes (2012) focuses on the mass/count distinction as a crosslinguistic phenomenon, and she points out several characteristics of classifier languages that seem incompatible with the view that such languages have no lexical mass/count distinction. First, it is often the case that classifier languages do not require classifiers in expressions corresponding to large numbers, as will be shown below with evidence from Japanese, (7.21). Doetjes (2012) also argues that countable individuals must be lexically encoded, because general classifiers, such as *ge* ($\text{CL}_{\text{general}}$) in Mandarin, which can replace sortal classifiers, does not contain information about the specific types of individuals that are to be counted. Lastly, classifier languages also can have determiners that are sensitive to the mass/count distinction, for example, Iljic (1994) has shown that the Mandarin determiner *yī diǎnr* ('a little') never occurs with a classifier, and it generally is used with substance denoting nouns and abstract nouns. With this evidence, Doetjes (2012) argues that the lexical entries of nouns encode criteria for counting, and therefore that classifier languages have a grammaticized lexical mass/count distinction.

7.3.3 Mass/count characteristics in Japanese: Sudo (2016, 2015)

The main argument of Sudo (2015) is that the denotation of Japanese nouns like *hon* ('book') are fundamentally different from those of nouns like *ase* ('sweat'). His evidence in support of this argument is based on constructions involving counting modifiers,

proportional quantifiers, and large round numbers. Counting modifiers *tasuu* ('many'), *shoosuu* ('few'), *nan-byaku-toiuu* ('what-100-say'), and *dono* ('which') are felicitous with count nouns but infelicitous with mass nouns, showing that these nouns are fundamentally different in some way.

(7.19) a. dono-ie-mo totemo furui
which-house-MO very old
'Every house is very old.'

b. #dono-ase-mo arainagashita
which-sweat-MO washed.off
Intended: '(I) washed off all the sweat.' (Sudo 2015, p. 6)

(7.20) a. sono tookoo-ni nan-byaku-toiuu komento-ga tsuita.
that post-TO what-100-say comment-NOM provided.
'That post got hundreds of comments.'

b. Taro-wa nan-byaku-toiuu ase-o kaita
Taro-TOP what-100-say sweat-ACC secreted
(intended) 'Taro sweated a lot.' (Sudo 2015, p. 5)

Likewise, the proportional quantifier *hotondo* ('most') only gets cardinality interpretations with count nouns, while it gets portion and measure interpretations with mass nouns, again showing a difference between the two classes of nouns. Finally, Sudo (2015) shows that large round numbers like 1000 and 100 do not always need classifiers in order to occur with nouns.

(7.21) sen-(choo)-no bairorin
1000-CL-GEN violin
'a thousand violins' (Sudo 2015, p. 4)

This is used to support his secondary argument, that, in Japanese, it is numericals that require classifiers in order to be predicates rather than nouns that require classifiers in order to be counted.

These claims are contrary to what Sudo (2015) calls the 'standard view of Japanese' in which the inability of Japanese nouns to be directly modified by numerals has been explained by all nouns being mass, or at the very least all having a uniformly different denotation from languages that allow direct modification of nouns by numerals (Borer 2005; Chierchia 1998a,b, 2010; Li 2011; Nemoto 2005; Rothstein 2010, among others). Sudo (2016, 2015) concludes that there are nouns in Japanese with countable denotations, and that nominal denotations in Japanese, a classifier language, are not so different from those in non-classifier languages like English.

Similar to Krifka's (1995) analysis of Mandarin, Sudo (2016, 2015) argues that numericals in Japanese denote arguments of type n and, therefore, cannot modify predicates on their own, rather they require classifiers in order to turn numericals into predicates. Classifiers are of type $\langle n, \langle e, t\rangle\rangle$, and together they form a predicate of type $\langle e, t\rangle$, which can modify nouns via Predicate Modification, (7.22-c).

(7.22) a. $[\![\text{roku}]\!] = \lambda w_s.6$

b. $[\![\text{roku-rin}]\!] = \lambda w_s \lambda x_e$: $^*\mathbf{flower}_w(x)$. $|\{y \sqsubset x$: $\mathbf{flower}_w(y)\}| = 6$

c. $[\![\text{roku-rin-no hana}]\!] = \lambda w_s \lambda x_e$: $^*\mathbf{flower}_w(x)$. $|\{y \sqsubset x$: $\mathbf{flower}_w(y)\}| = 6 \wedge {}^*\mathbf{flower}_w(x)$

(Sudo 2016, p. 5)

For classifiers like *kumi* ('pair') and *daasu* ('dozen'), Sudo (2016) assumes that these classifiers encode the function $\mathbf{atomic}_w$ to identify countable entities, and an operation, (7.23), that specifies that two entities do not overlap.

(7.23) $x \between y$ is true iff $\{z : z \sqsubseteq x\} \cap \{z : z \sqsubseteq y\} \neq \varnothing$ (Sudo 2016, p. 6)

(7.24) $[\![\text{-kumi}]\!] = \lambda w_s \lambda n_n \lambda x_e . \exists y_1 ... y_n [x = y_1 ... _n \wedge \forall y_i [\,|\{z \sqsubseteq y_i : \mathbf{atomic}_w(z)\}| = 2 \wedge \neg \exists y_j [y_i \between y_j \wedge y_i \neq y_j]]]$

(Sudo 2016, p. 6)

These classifiers do not have sortal presuppositions that restrict them to certain kinds of individuals, and are therefore able to count anything so long as it is atomic and non-overlapping. While Sudo (2016) does not define atoms or subscribe to a particular theory of the mass/count distinction, his analysis of classifiers reveals the assumption that countable nouns denote atoms that do not overlap.

7.3.4 Interim conclusions

The evidence for reflexes of a mass/count distinction in classifier languages is not wholly incompatible with analyses like Chierchia (2010, 2015) in which all nouns in such languages denote kinds but are nevertheless different in the sense that some kinds are the supremum of a stably atomic semi-lattice while others are the supremums of semi-lattices made from unstable atoms. The cardinality judgments conducted by Inagaki and Barner (2009) can be accommodated so long as the comparison construction has a means of specifying cardinality judgments for stably atomic kinds and others for those of unstable atoms. A similar approach can be taken for the determiners addressed by Doetjes (2012) and

Sudo (2015), that is, count determiners must encode an atomicity requirement along the lines of that proposed for individual classifiers by Chierchia (2015). So while it has been argued that there are nouns with countable denotations in classifier languages (Sudo 2015, p. 8), and that such denotations are not so different from those in non-classifier languages like English (Sudo 2016, p. 2), there is not yet conclusive proof of this claim.

What might be the leading insight about the classifier system in languages like Mandarin, as Doetjes (2012) points out, is the question that is posed by the general classifier, namely how does it specify which individuals are to be counted? This is particularly problematic for nouns that denote entities that can be counted in multiple ways. As Zhang (2007) shows, the Mandarin noun *kè* ('class') can be counted with the classifier *táng* to count individual class sessions, and it can be counted with the classifier *mén* to count courses that span an entire semester. Assuming an analysis like that of Chierchia (2015), both individual sessions and entire courses might be considered countable atoms in the denotation of *kè* ('class'), and if the general classifier *ge* does not carry any means of specifying a particular sort of atom, then overlapping individuals could be counted at the same time. This would mean that if a student enrolled in a single course that occurs over twelve class sessions, then the general classifier would allow the student to say they are attending thirteen classes. This parallels the overlap in counting that Landman (2011) characterizes in his analysis of object mass nouns. In the same way that *piece* can be used to identify individuals in disjoint sets in the denotation of *furniture*, the Mandarin classifiers *táng* and *mén* pick out individuals from disjoint sets in the denotation of *ké* ('class').

Two resolutions might be proposed to resolve the problem of counting overlapping individuals in the denotation of nouns like *kè* ('class'): (i) one might assume that *kè* is polysemous and has two distinct denotations, one for sessions and one for courses, or (ii) there might be a means of specifying countable individuals with respect to context as proposed by Rothstein (2010). Assuming the latter, one might choose to encode contextual specification in the classifier, maintaining the nominal semantics in an account like that of Chierchia (2010, 2015), however doing so would require the same specification to be built in to count determiners as well. Alternatively, one could encode the contextual specification in the noun, in which case nominal predicates in classifier languages would look much more like those in number marking languages.

What remains to be seen is whether or not classifier languages have a class of object mass nouns and therefore a grammaticized lexical mass/count distinction that cannot be reduced to the substance/object distinction rather than the grammatical countability of nouns. Despite the evidence gathered and arguments made by Inagaki and Barner (2009); Doetjes (2012) and Sudo (2016, 2015), individuation alone could motivate the

observed distributional patterns of determiners and nouns. The existence of object mass nouns in classifier languages, however would prompt the need for an alternative account of the nominal semantics in classifier languages, namely one in which such patterns arise due to a grammaticized lexical mass/count distinction.

7.4 Investigating object mass nouns in Japanese

The main goal of Erbach et al. (2017), was to test for object mass nouns in Japanese by building mainly on the observations about Japanese determiners by Sudo (2015). An online survey was conducted in which participants were asked to judge the felicity of sentences on a five point Likert scale from 1, *hen da* ('odd') to *yoi* ('OK'/'good'). The test sentences in this study each contained the numerical determiner *nan-byaku-to-iu* ('hundreds of') composed with a noun from one of three notional classes. The three notional classes of nouns were discrete individuals, e.g. *onna.no.hito* ('woman' (7.25)), unindividuated stuff, e.g. *yuki* ('snow' (7.26)), and collections of discrete entities, e.g. *yūbinbutsu* ('mail' (7.26)). A total of 44 nouns were tested: 11 referring to discrete individuals, 11 referring to unindividuated stuff, and 22 referring to collections of discrete entities.

(7.25) toranpu-shi ga daitoryō ni na-tta ato,
Trump-president NOM president ACC become-PST after

nan-byaku-to-iu onna.no.hito ga washinton de neriarui-ta
what-hundred-to-say woman NOM Washington LOC march-PST
'After Trump became president, hundreds of women marched in Washington DC.'
(Erbach et al. 2017, p. 238)

(7.26) #nan-byaku-to-iu yuki wa mō toke-te shima-tta
what-hundred-to-say snow NOM already melt-TE finish-PST
'#Hundreds of snow melted already.' (Erbach et al. 2017, p. 237)

(7.27) #senshū mo nan-byaku-to-iu yūbinbutsu o mora-tte i-ta
last.week too what-hundred-to-say mail ACC get-TE PROG-PST
#'Last week they got hundreds of mail.' (Erbach et al. 2017, p. 238)

None of these sentences contained a classifier, and thereby provided a suitable environment for testing whether or not the nouns in question denote countable sets of entities. Given Sudo's (2015) argument that *nan-byaku-to-iu* ('hundreds of') is a count determiner, nouns that denote countable sets of entities should be judged to be felicitous with *nan-byaku-to-iu* ('hundreds of')—i.e. they should get average ratings closer to 5—while

nouns that do not denote countable sets of entities should be judged to be infelicitous with *nan-byaku-to-iu* ('hundreds of')—i.e. they should get an average rating closer to 1. Crucially if any object denoting nouns were to be judged to be infelicitous with *nan-byaku-to-iu* ('hundreds of'), then this would be an indication that these are object mass nouns.

The results of the study seem to suggest that Japanese has at least one object mass noun, namely *yūbinbutsu* ('mail'), though we will see in the next section that a number of confounds could have lead to this result. As predicted by Sudo (2015), there was a clear bipartite split in the judgments of object and substance denoting nouns, which serves to distinguish a class of count nouns and a class of mass nouns. The average judgment of sentences containing *nan-byaku-to-iu* ('hundreds of') and nouns like *onna.no.hito* ('woman') that denote discrete individuals was closer to 5, while the average judgment of sentences with nouns like *yuki* ('snow') that denote undifferentiated stuff was closer to 1. *Yūbinbutsu* ('mail') also received an average judgment closer to one, and in this respect displays one of the characteristic properties of object mass nouns, namely behaving like substance denoting mass nouns in certain grammatical environments.

To be sure that *yūbinbutsu* ('mail') can be considered object denoting in the sense that the entities it refers to can be counted, Erbach et al. (2017) constructed quantity comparison tasks along the lines of those in Inagaki and Barner (2009). Consultants were presented with a description of a scenario in which one agent possessed an amount of an entity that is higher in cardinality but lower in volume/are than the amount possessed an second agent, e.g. (7.28).

(7.28) Yuma wa futa-tsu no fūtō o uketo-tta. Hito-tsu wa atarashī
Yuma TOP two-CL GEN envelopes ACC receive-PST. one-CL TOP new

shigoto no keiyaku de, mō-hito-tu wa apāto no keiyaku da.
work GEN contract and, another-one-CL TOP apartment GEN contract COP.

Satomi wa itsu-tsu no chīsai fūtō o uketo-tta.
Satomi TOP five-CL GEN small envelope ACC receive-PST.

Doremo tomodachi kara no chīsai tegami o fukun-de iru.
Both friend from GEN small letter ACC contain-TE IRU.

'Yuma received two large envelopes, one with her new work contract and one with her apartment contract. Satomi got five small envelopes, each containing a short letter from a friend.' (Erbach et al. 2017, p. 239)

Participants were then asked who has more with respect to the noun in question. In the case of *yūbinbutsu* ('mail'), consultants gave judgments based on cardinality, confirming that *yūbinbutsu* ('mail') denotes individuals that can be counted in a certain context.

This characteristic, along with being infelicitous with count determiners means that *yūbinbutsu* ('mail') displays the key characteristics of an object mass noun.

In Erbach et al. (2017), object mass nouns, count determiners, and classifier constructions in Japanese are accounted for in much the same way that these phenomena are accounted for in Hungarian by Erbach et al. (2019). Japanese nominal predicates are assumed to be number neutral and classifiers turn numeral denoting numerical expressions into numerical modifiers that combine with a number neutral noun.

(7.29a) $[\![san]\!]^{c_i} = 3$

(7.29b) $[\![bu]\!] = \lambda n.\lambda P.\lambda c.\lambda x.\langle \pi_1(P(x)),\ \mu_{card}(x, \lambda y.c(\pi_2(P(x)))(y)) = n,$
$\mathrm{DISJ}(\lambda y.c(\pi_2(P))(x)(y))$
$\wedge\ \lambda x.\pi_1(P(x)) \subseteq \textsc{printed.item}\rangle$

(7.29c) $\forall P.\forall c.[c(c_0(P)) \longleftrightarrow c(P)]$

(7.29d) $[\![y\bar{u}binbutsu\ san\text{-}bu]\!]^{c_i} = \lambda x.\langle {}^{*}c_0\mathbf{IND}(\mathrm{MAIL}(x),$
$\mu_{card}(x, \lambda y.c_i(\mathbf{IND}(\mathrm{MAIL})(y)) = 3,$
$\mathrm{DISJ}(\lambda y.c_i(\mathbf{IND}(\mathrm{MAIL})(y))\ \wedge$
${}^{*}c_0\mathbf{IND}(\mathrm{MAIL}) \subseteq \textsc{printed.item}\rangle$

(Erbach et al. 2017, p. 243)

Count determiners like *nan-byaku to iu* ('hundreds of') are sensitive to whether or not the counting base of a nominal predicate is disjoint, so it can felicitously compose with a count noun like *isu* ('chair'), which has a disjoint counting base, but it cannot occur with a mass noun, which does not have a disjoint counting base.

(7.30a) $[\![nan\text{-}byaku\text{-}to\text{-}iu]\!] = \lambda P.\lambda x.\langle \pi_1(P(x)), \mu_{card}(x,\ \pi_2(P(x))) \geq n_c,$
$\mathrm{DISJ}(\pi_2(P(x)))\rangle$

(7.30b) $[\![nan\text{-}byaku\text{-}to\text{-}iu\ isu]\!] = \lambda x.\langle \mathrm{CHAIR}(x),$
$\mu_{card}(x,\ \lambda y.\ c_i(\mathbf{IND}(\mathrm{CHAIR})(y)) \geq n_c,$
$\mathrm{DISJ}(\lambda y.\ c_i(\mathbf{IND}(\mathrm{CHAIR})(y))\rangle$

(Erbach et al. 2017, p. 243)

7.4.1 Further investigation

Building on the work in Erbach et al. (2017), I here present another study with the exact same set up albeit with different nouns in each of the three notional classes. The purpose of the study

was to further test an additional 23 artifactual aggregate nouns in this grammatical context to see if more nouns than just *yūbinbutsu* ('mail') displays the characteristic properties of object mass nouns, e.g. (7.31)–(7.33).

(7.31) Atarashī gakkiten wa kinō nan-byaku-to-iu kizai o u-tta.
new music.store TOP yesterday what-hundreds-TO-say equipment ACC sell-PST
#'The new music store sold hundreds of equipment yesterday.'

(7.32) #Nan-byaku-to-iu shokki ga shinku ni ranzatsu ni aru.
what-hundred-TO-say dishware NOM sink LOC clutter RES exist
#'There are hundreds of dishware cluttering the sink.'

(7.33) #Atarashī ryōri no gakkō wa nan-byaku-to-iu chōrikigu o ka-tta.
new cooking GEN school TOP what-hundred-to-say kitchenware ACC buy-PST

Dakara subete no seito ga benkyōsuru tame no potto to furaipan o
therefore all GEN student NOM study for GEN pot and pan ACC

mo-tta.
hold-PST
#'The new culinary school bought hundreds of kitchenware, so every student had pots and pans to work with.'

Filler sentences consisted of adjective-noun combinations, a subset of which were infelicitous, e.g. 'silver children', so the set of survey items had an equal number of felicitous and infelicitous filler constructions and target constructions as far as they could be predicted. An additional change from the previous study is that the labels on the ends of the Likert scale were changed to *zenzen yokunai* ('not at all good') and *totemo yoi* ('very good'). Each sentence was judged by 50 native speakers via the crowd-sourcing platform www.crowdworks.jp.

7.4.1.1 Results

The graph in Figure 7.2 shows the average judgments according to notional class—i.e. whether the noun refers to discrete individuals, e.g. *onna.no.hito* ('woman'), unindividuated stuff, e.g. *yuki* ('snow'), and collections of discrete entities, e.g. *yūbinbutsu* ('mail'). Nouns referring to discrete individuals were judged to have high average acceptability ($\bar{x} = 4.20$) with *nan-byaku-to-iu* ('hundreds of'), whiles nouns referring to unindividuated stuff have a low average acceptability ($\bar{x} = 2.76$), and nouns referring to collections of discrete entities, as a group, are judged in between ($\bar{x} = 3.77$).

Results were analyzed using a Generalized linear mixed effects model via the lme4 package in R. The random effects were item and participant and the fixed effect was notional class. The analysis showed that, as a class, sentences with nouns referring to collections of discrete entities were judged to be less felicitous than those with nouns referring to discrete individuals ($p < 0.01$), and, as would be expected following Sudo (2015) and Erbach et al. (2017), sentences with nouns

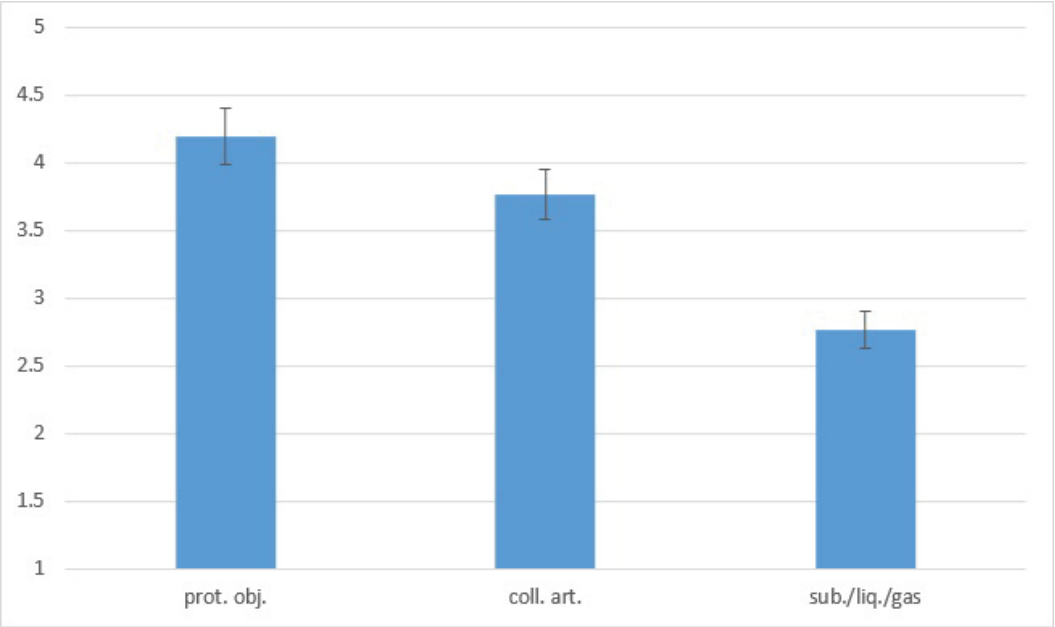

FIGURE 7.2: Average judgment by N class

referring to unindividuated stuff were judged to be less felicitous than those with nouns referring to discrete individuals as well ($p < 0.001$).

Given that it is not the case that all nouns referring to collections of discrete entities behave the same way in a given languages—e.g. *shoe* is count but *footwear* is mass—we also looked at the average judgment of each noun in this class, rather than only looking at this group as a whole. Looking at the results in this way revealed a gradient in acceptability judgments, as is common in acceptability judgment tasks (e.g. Bresnan 2007; Bresnan and Ford 2010; Chomsky 1964; Featherston 2005; Keller 2000; Newmeyer 2007; Sorace and Keller 2005; Sprouse 2007). This gradient allows us to categorize nouns referring to collections of discrete entities into three groups: (i) those that pattern with nouns that refer to discrete individuals ($n = 7$, $\bar{x} = 4.22$, $p = 0.567$, effect size < 0.2), (ii) those that weakly do not pattern with nouns that refer to discrete individuals ($p < 0.05$, $\bar{x} = 3.71$, $n = 7$, effect size 0.5–0.8), and (iii) those that strongly do not pattern with nouns that refer to discrete individuals ($n = 4$, $\bar{x} = 3.21$, $p < 0.001$, effect size > 0.8)

Looking more closely at the judgments of particular nouns shows that participant judgments were distributed differently across the Likert scale for the different classes of nouns. Participants tended to agree the most strongly about nouns referring to discrete entities: the average number of judgments at the highest point on the Likert scale (point 5, *totemo yoi* 'very good') was 26, and the average number of judgments was 18 at the second highest point on the scale (point 4). The large average numbers of 4 and 5 judgments on the Likert scale show strong agreement about the felicity of nouns that refer to discrete individuals with *nan-byaku to iu* ('hundreds of'). For nouns that refer to unidividuated stuff, participants tended toward the lower end of the Likert scale, though not in a manner as strong as the manner in which judgments for nouns referring to discrete individuals patterned towards the high end of the Likert scale. Collectivel,y nouns that refer to unidividuated stuff received an average of 8 judgments at the lowest point on the Likert scale (*zenzen yokunai* 'not at all good'), and 18 judgments at the second lowest

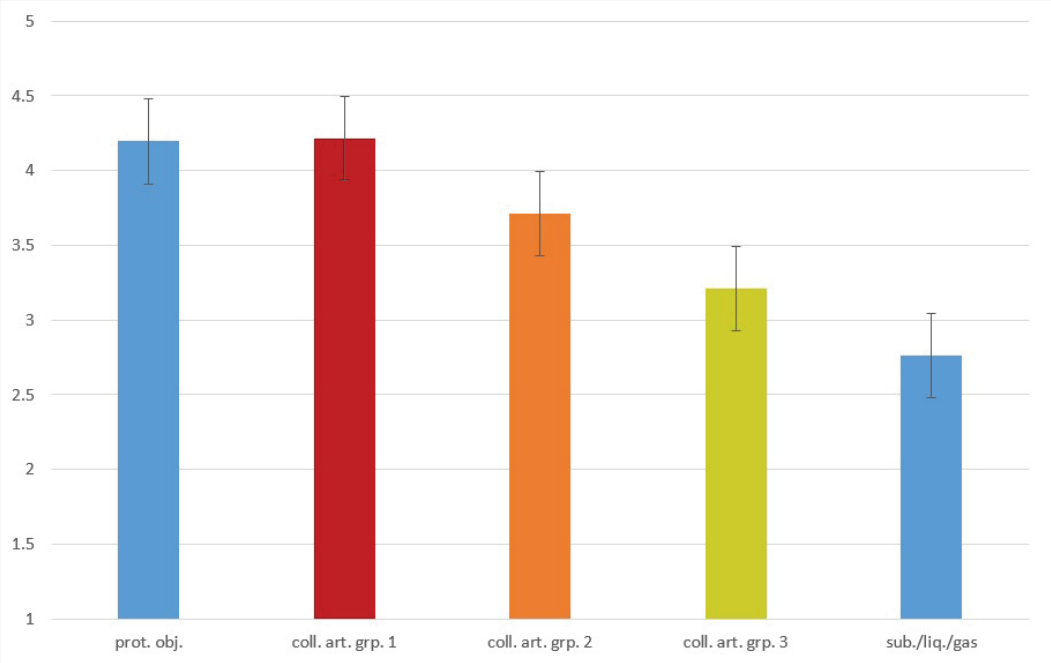

FIGURE 7.3: Average judgment of nouns with *nan-byaku-to-iu* ('hundreds of')

point on the scale. The average numbers of 1 and 2 judgments on the Likert scale show, not a strong agreement, but rather a general tendency for nouns that refer to unidividuated stuff to be judged as infelicitous with *nan-byaku to iu* ('hundreds of'). With respect to the nouns that refer to collections of individuals, those in group 1, which pattern with nouns that refer to discrete individuals, received similar average numbers of judgments on the Likert scale (an average of 27 judgments at point 5, and 17 at point 4), while those in group 2, which weakly do not pattern with nouns that refer to discrete individuals, received fewer judgments (an average of 17 judgments at point 5, and 19 at point 4), and those in group 3, which strongly do not pattern with nouns that refer to discrete individuals, looked more like nouns that refer to unidividuated stuff with respect to the average number of judgments across the Likert scale (an average of 6 judgments at point 1, and 14 at point 2, 16 at point 4 and 7 at point 5). The judgments of nouns in group three, such as *kattamono* ('shopped goods'), show that these nouns do not seem to be strongly encoded in the same way as nouns that refer to discrete individuals, such as *hon* ('book'), rather nouns in group three tend to be judged much more similarly to nouns that refer to unidividuated stuff, like *ase* ('sweat'). In summary, participant judgments were distributed differently across the Likert scale for the different classes of nouns, and the patterns in these distributions show further similarities between certain classes of nouns.

7.4.1.2 Discussion

The results show that the sentences tested were judged significantly differently with respect to acceptability, giving rise to a class of nouns, some of which are considered mass, and some of which are considered mass. These results are summarized in Table 7.1. Seven nouns referring to collections of discrete entities patterned like nouns referring to discrete individuals and can be

categorized as count, seven nouns referring to collections of discrete entities do not pattern with nouns referring to discrete individuals, albeit weakly so, and could be categorized as mass nouns in the sense that they do not strictly pattern with nouns referring to discrete individuals. Four other nouns referring to collections of discrete entities do not pattern with nouns referring to discrete individuals, and they do so strongly, and therefore can be categorized as mass nouns. Assuming these last two sets of nouns denote countable individuals, they are potential candidates for object mass nouns in Japanese.

Table 7.1: Summary of results from Study 2

Judgment Class	Nouns
✓, felicitous	*haikibutsu* ('waste')
	kizai ('equipment')
	yōfuku ('western clothes')
	chōri-ki ('kitchenware')
	yūbin ('mail')
	daidokoro yōhin ('kitchenware')
	kutsu ('footwear')
?, weakly infelicitous	*shōhin* ('goods/wares')
	kagu ('furniture')
	shokki ('dishware')
	sōbi ('equipment')
	dōgu ('tools')
	yūbinbutsu ('mail')
	gomi ('garbage')
#, strongly infelicitous	*hakimono* ('footwear')
	shinamono ('wares/articles')
	kattamono ('shopped goods')
	chōri-kigu ('kitchenware')

The results of this study might be interpretable as indicating that Japanese has a straightforward mass/count distinction with object mass nouns, but there are nevertheless several reasons why further discussion is warranted. First, as mentioned, the gradient across judgments, while common in acceptability judgment tasks, is in no way predictable by current theories of the mass/count distinction. Second, the average judgment of of sentences containing nouns referring to discrete individuals was somewhat low ($\bar{x} = 4.20$) compared to the the highest possible judgment, 5, which would be expected for sentences that are straightforwardly grammatical and felicitous. Thirdly, the average judgment of sentences containing nouns referring to undifferentiated stuff was relatively high ($\bar{x} = 2.76$) compared to the lowest possible rating, 1, which ought to be given to a sentence that is ungrammatical and infelicitous. In sum, one might predict that sentences with nouns referring to discrete individuals to be judged higher, sentences with nouns referring to unindividuated stuff to be judged lower, and sentences with nouns referring to collections of individuated entities to pattern more like one of the two other groups, rather than somewhere in between.

As for sentences containing nouns referring to unindividuated stuff and their somewhat higher-than-might-be-expected judgments, one consultant reported that certain nouns might have been shifted to portion interpretations. *Nendo* ('clay'), *kabi* ('mold'), and *nenryō* ('fuel'), for example,

were the target nouns in sentences that received relatively high acceptability judgments, and could have been interpreted as referring to portions of the respective substances. The consultant reported that, when *nan-byaku-to-iu* ('hundreds of') is composed with a noun referring to unindividuated stuff that gets a portion reading, the interpretation of *nan-byaku-to-iu* ('hundreds of') is not as literal as in the case of nouns referring to discrete individuals, rather it has a reading more like 'uncountably many'. Portion interpretations of these nouns, when composed with *nan-byaku-to-iu* ('hundreds of') could have lead to higher than expected judgments of these sentences, thereby driving the average of all sentences containing nouns referring to unindividuated stuff higher.

To address these concerns we conducted a follow-up investigation, in which we asked a consultant to give a more careful analysis of the sentences than the quick rating on a Likert scale given by participants in the study. The consultant reported that several sentences were long and missing commas, and, given Japanese word order, these sentences could be hard to parse. Difficulty in parsing could be one explanation for the low judgments of sentences with nouns referring to discrete individuals or collections of individuated entities.

In the follow-up investigation, the consultant also reported that some sentences were pragmatically odd in the sense that they clashed with world knowledge. For example, the sentence containing *nan-byaku-to-iu piano* ('hundreds of pianos') stated that a particular store sold hundreds of pianos in a single day, which, given world knowledge is particularly unlikely, even in a very large city like Tokyo. The same sort of pragmatic clash resulted when the interpretation of *nan-byaku-to-iu* ('hundreds of') was 'uncountably many' rather than a more strict cardinal interpretation, given it was unclear why any number of, e.g. pianos, might not be countable. This sort of pragmatic infelicity/knowledge clash could, therefore, be another reason with nouns referring to discrete individuals or collections of individuated entities were judged to be somewhat less acceptable than might be expected.

A third reason why certain sentences might have gotten low acceptability judgments, according to the consultant, is that some sentences contained constructions from incompatible registers. For example, *otokonoko* ('boy') and *kattamono* ('shopping$_{N}$') were reported to be quite casual words compared to the rest of the sentences in which they were used, which were more formal in register. Somewhat similarly, certain words are homonyms whose more frequent interpretation might lead to a lower judgment than the intended interpretation, e.g. *shiromuku* ('undergarment' or 'wedding dress'). Clashes in register and interpretation could also have lead to low acceptability judgments of sentences containing nouns referring to discrete individuals or collections of individuated entities.

Certain sentences with nouns referring to discrete individuals or collections of individuated entities could have received relatively low judgments because of one or more of the reasons given above. The sentence containing *chorikigu* ('kitchenware'), for example was long, would have benefited from commas, and contained a mix of words that are typically found in more formal and informal registers respectively. These factors, more so than perhaps being a mass noun and therefore incompatible with a count determiner like *nan-byaku-to-iu* ('hundreds of'), could have lead to the somewhat low judgments of this particular sentence.

While discussing possible reasons for low judgments of the sentences, we also asked whether the DP itself was a felicitous construction. In some instances, the consultant's judgment of only *nan-byaku-to-iu* ('hundreds of') plus a noun was in line with our study, but in 6 instances, the two were not aligned, leading to the assumption that it was grammatical or pragmatic errors other that lead to low acceptability judgments rather than composition with *nan-byaku-to-iu* ('hundreds of'). These results are summarized in Table 7.2, where nouns that have changed categorization are in bold.

Table 7.2: Summary of Results Consultation

Felicity with *nan-byaku-to-iu* ('hundreds of')	Nouns
✓, felicitous	*haikibutsu* ('waste')
	kizai ('equipment')
	yōfuku ('western clothes')
	chōri-ki ('kitchenware')
	yūbin ('mail')
	daidokoro yōhin ('kitchenware')
	kutsu ('footwear')
	***yūbinbutsu* ('mail')**
	***gomi* ('garbage')**
	***shōhin* ('goods/wares')**
	***hakimono* ('footwear')**
	***chōri-kigu* ('kitchenware')**
#, infelicitous	*kagu* ('furniture')
	shokki ('dishware')
	sōbi ('equipment')
	dōgu ('tools')
	shinamono ('wares/articles')
	kattamono ('shopped goods')

7.4.1.3 Counting collective artifact nouns in Japanese

To begin to discriminate whether low judgments of certain nouns referring to collections of individuated entities were due to these nouns being object mass nouns and therefore incompatible with *nan-byaku-to-iu* ('hundreds of') or due to some combination of the characteristics discussed above, we began a preliminary investigation into counting constructions with these nouns. With our consultant, we investigated the acceptability of these nouns in counting constructions, which classifiers can be used with these nouns, and exactly what can be counted when these nouns are acceptable in counting constructions.

The primary assumption behind this preliminary investigation is that, if these nouns are straightforwardly countable like nouns that refer to discrete individuals, e.g. *inu* ('dog'), then the individuals should be countable irrespective of their subkinds. For example one would, of course, count two golden retrievers and a black lab as *three dogs*, however two packages of basmati rice and one package of jasmine rice is not as straightforwardly acceptable as *three rices*, given the two subkinds present. With respect to object mass nouns, counting subkinds could, in theory be possible as in the case of *rices* above. While Sutton and Filip (2016b) have argued that English

object mass nouns resist coercion in count syntax because of their overlapping subkinds, it seems that, in Japanese, it might be the case that classifiers provide a means for enforcing counting schema of subkinds that are disjoint from one another. For example, *chōri-ki* ('kitchenware') can be categorized according to subkinds based on purpose—e.g. appliances, cookware, serving-ware, etc.—and these subkinds overlap with those based on items—e.g. chopping boards, knives, mixing bowls, etc. So, with a sub-kind reading, a set consisting of a chopping board and two knives is never predicted to be acceptable as 'three kitchenwares', and neither is cookware, cutting boards, and knives. For *chōri-ki* ('kitchenware'), if it can be counted at all coercable at all, a set containing a chopping board, a knife, and a mixing bowl, might be considered acceptable, given the three subkinds of kitchenware are disjoint from one another. As we will see, there is tentative evidence that this might be an acceptable situation for counting *chōri-ki* ('kitchenware'), though it does not seem to be the case that individuals can be counted when the cardinality of their subkinds is not equal to the cardinality of the individuals.

Building on these assumptions, if the Japanese nouns in question are acceptable when counting sets of individuals whose cardinality is different than that of their subkinds, then they must be count nouns, while those that cannot be counted in this way must be mass nouns. With respect to the sentences in (7.34), (7.34-a) should be an acceptable description of three chairs, a table, and a sofa if *kagu* ('furniture') is a count nouns, but it should be unacceptable if it is a mass noun. Likewise, (7.34-b) should be an acceptable description of two pots, their lids, and a ladle if *chōri-kigu* is a count noun, but this should be unacceptable if it is a mass noun.

(7.34) a. kagu itsu-tsu
furniture five-$\text{CL}_{general}$
'five pieces of furniture'

b. chōri-kigu itsu-tsu
kitchenware five-$\text{CL}_{general}$
'five pieces of kitchenware'

The result of the elicitation session is that certain nouns that refer to collections of individuated entities are straightforwardly acceptable for counting discrete individuals while others are not. In all of the examples, the general classifier *tsu* is preferred given the sets of individuals are heterogeneous with respect to the type of classifier they would normally take. For example, both knives and cutting boards are considered *chori-ki* ('kitchenware'), but knives would be counted with the classifier *choo* (CL_{tool}), but cutting boards and bowls would not.

Shohin ('goods') can straightforwardly be used to count inventory in a store even if the number kinds does not equal the number of individuals.

(7.35) itsu-tsu no shohin
five-CL GEN goods
'five goods' (Sounds best written–e.g. a newspaper report)

Daidokoro yōhin ('kitchenware') and *chōri-ki* ('kitchenware'), on the other hand, cannot be used to count discrete individuals if the number of kinds does not equal the number of individuals. For

example, counting a cutting board and two knives as *mit tsu* (three CL) is not acceptable, while counting a cutting board, a knife, and a mixing bowl is acceptable as in the examples below.

(7.36) mit-tsu no daidokoro.yohin
three-CL GEN kitchenware
#'three kitchenwares'
#(chopping board, two knives)
✓(chopping board, knife, mixing bowl)

(7.37) mi-tsu no chōri-ki
three-CL GEN kitchenware
#'three kitchenwares'
#(chopping board, two knives)
✓(chopping board, knife, mixing bowl)

These examples support the idea that certain Japanese nouns have the behavior of object mass nouns in that they cannot straightforwardly be counted, even with classifiers, nor are they felicitous with count determiners like *nan-byaku-to-iu* ('hundreds of').

Another instance where discrete entities cannot be straightforwardly counted in a classifier construction is with *hakimono* ('shoes') and the classifier *soku* ('foot'). Together, these are generally used to count pairs of shoes rather than individual shoes, as in (7.38) and (7.39).

(7.38) san-soku no hakimono
three-CL$_{foot}$ GEN footwear
'three pairs of footwear'
#'three shoes'

(7.39) hakimono o mit-tsu
footwear ACC three-CL$_{general}$
'three pairs of footwear'
#'three shoes'

While this shows it is possible to count *hakimono* ('footwear'), it also shows that individual shoes are not at the bottom of the semi-lattice denoted by *hakimono* ('footwear'), rather pairs of shoes are. In order to count individual shoes, a single shoe must be specified via *katahōno* as in (7.40).

(7.40) katahōno hakimono ga mi-tsu
one.side.of footwear SUBJ three-CL
'three shoes'

The results of the investigation into counting with the nouns in question, unfortunately, does not straightforwardly align with the categorization of these nouns determined from the study and follow-up on the felicity of the DP containing *nan-byaku-to-iu* ('hundreds of') and the

nouns. While it does confirm the lack of countability of four nouns, *kagu* ('furniture'), *shokki* ('dishware'), *sōbi* ('equipment'), and *dōgu* ('tools'), it also calls the countability of other nouns back into question. These results are summarized in Table 7.3, where ✓ corresponds to 'felicitous' judgments, ? corresponds to weakly infelicitous judgments, and # corresponds to strongly infelicitous judgments.

Table 7.3: Noun Categorization Comparison

Noun	Survey Judgment	DP Judgment	Counting Judgment
kizai ('equipment')	✓	✓	✓
kutsu ('footwear')	✓	✓	✓
haikibutsu ('waste')	✓	✓	#
yōfuku ('western clothes')	✓	✓	#
chōri-ki ('kitchenware')	✓	✓	#
yūbin ('mail')	✓	✓	#
daidokoro yōhin ('kitchenware')	✓	✓	#
shōhin ('goods/wares')	?	✓	✓
yūbinbutsu ('mail')	?	✓	✓
gomi ('garbage')	?	✓	✓
hakimono ('footwear')	#	✓	✓
chōri-kigu ('kitchenware')	#	✓	#
kagu ('furniture')	?	#	#
shokki ('dishware')	?	#	#
sōbi ('equipment')	?	#	#
dōgu ('tools')	?	#	#
shinamono ('wares/articles')	#	#	#
kattamono ('shopped goods')	#	#	#

7.4.2 Summary

The evidence from this investigation suggests that it is a distinct possibility that Japanese has object mass nouns and likewise a grammaticized lexical mass/count distinction. Six nouns in particular, two of those that strongly did not pattern with nouns that refer to discrete individuals in our survey, were also judged to be infelicitous in two count constructions by our consultant. Composition with the quantifying determiner *nan-byaku-to-iu* ('hundreds of') was used both in our study and in more detailed consultation. These investigations have shown that *nan-byaku to iu* ('hundreds of') is a suitable test for countability. Nouns referring to discrete individuals are felicitous with *nan-byaku-to-iu* ('hundreds of'), while nouns referring to unindividuated stuff are infelicitous with this quantifying determiner. This confirms the claim of Sudo (2015) that Japanese nouns have denotations that are compatible with counting modifiers, and it opens up the possibility of testing for object mass nouns in Japanese, which has been reported both in Erbach et al. (2017) and this thesis. These investigations show that there is a small number, two-to-six, of nouns that refer to collections of individuals that have the characteristic properties of object mass nouns, namely (i) they are shown to denote objects that are not straightforwardly countable but sometimes semantically accessible via a battery of semantic tests, and (ii) they pattern similarly, but not necessarily identically, to substance mass nouns across morphosyntactic environments.

The potential object mass nouns in Japanese were shown to denote objects in both quantity comparison tasks and the ability to be counted with a sortal/individual classifier, and these nouns were seen to pattern similarly to substance mass nouns in that both patterned strongly unlike nouns that refer to discrete individuals with respect to felicity with *nan-byaku to iu* ('hundreds of') and both were not strongly infelicitous rather they tended towards infelicity with respect to judgments across the Likert scale. The other construction used to test for countability is counting DPs where the cardinality of kinds is not aligned with the cardinality of discrete individuals. The evidence for other nouns that refer to collections of individuals is less clear suggesting that they might be infelicitous in one count construction but felicitous in another and therefore do not exhibit the grammatical properties indicative of object mass nouns as straightforwardly as those like *shinamono* ('wares/articles') and *kattamono* ('shopped goods').

7.5 Discussion of previous analyses

If this data can be accepted as evidence that the Japanese grammatical mass/count distinction does not align with the notional substance/object distinction, then there are significant consequences for previous analyses of nouns in classifier languages. Primarily, as suggested by Sudo (2015) the Japanese nominal system would not be as typologically distinct from number-marking languages as has been previously assumed.

Determiners in classifier languages pose a particular challenge to all analyses of classifiers, whether classifiers are assumed to combine with kind denoting nouns to make them countable predicates (e.g. Chierchia 1998a, 2010, 2015; Rothstein 2010, 2017), or classifiers are assumed to combine with numericals in order to make them modifiers (e.g. Krifka 1995; Sudo 2016; Erbach et al. 2017). The determiners described by Li (2011) pose a challenge because there is not uniform behavior with respect to whether or not classifiers are required, optional, or ungrammatical with the composition of a determiner and a noun.

With respect to analyses that argue classifiers combine with numeral denoting numericals to make them modifiers, there is no straightforward reason why determiners would require or optionally allow classifiers. The data might be accounted for if these determiners are assumed require or allow for singular arguments, as is the case for *every* and *each* in English, in which case one might assume a morphologically null realization of the numeral 1, with which a classifier could compose to enforce a singular reading of the noun.

The analyses in which classifiers are required to turn kind denoting nouns into countable predicates seems somewhat better situated for being extended to determiners. Determiners requiring classifiers could be analyzed as unable to compose with kind denoting nouns, while determiners that do not permit classifiers could be analyzed as only being able to compose with kind denoting nouns. Determiners that optionally allow classifiers could be analyzed as having two distinct forms, one that only composes with kind denoting nouns and one that does not, though this also requires an explanation for why a language might have determiners specifically for kind denoting nouns, others for nominal predicates and others still that compose with both kind denoting nouns and nominal predicates.

The Japanese determiners described by Sudo (2015), and the follow-up studies by Erbach et al. (2017) pose an additional challenge to analyses of the nominal systems in classifiers languages. This section will discuss the ramifications that the data discussed in this chapter has for previous accounts of classifier languages.

7.5.1 Chierchia (1998a, 2010, 2015)

Across his three analyses of nouns in classifier languages, Chierchia (1998a, 2010, 2015) has gradually changed his position on the way that a mass/count distinction would be encoded in classifier languages. Early on, Chierchia (1998a) states that all nominal predicates are mass in classifier languages, though a mass/count distinction might arise at a phrasal level given nouns refer to entities from distinct natural classes. The position that all nominal predicates are mass is later recanted and instead, all nouns are treated as number neutral in classifier languages, and mass nouns are assumed to be singleton properties in number marking languages like English (Chierchia 2010, 2015). This latter analysis, in which there is a distinction between stable atoms and unstable individuals, makes explicit how the mass/count distinction can arise at a phrasal level in classifier languages, namely via sensitivity to the type of atoms in the denotation of a nominal predicate. Despite this sort of sensitivity, this analysis would require extensions/modifications in order to accommodate some of the data discussed above, such as potential object mass nouns in Japanese.

Certain classifiers, like *soku* ('foot'), present a challenge to analyses of countability that rely on atomicity for counting. Because *soku* ('foot') is used to count pairs, but does not literally refer to pairs, this counting construction presents a challenge to existing accounts of individual/sortal classifiers, which typically are assumed to count atoms that correspond to discrete objects. In order to maintain an approach to classifiers like that in Chierchia (2010, 2015), one might assume that *soku* ('foot') has taken on the meaning of 'pair' in this context in addition to having a literal use as 'foot' in other contexts, and is therefore polysemous. If *soku* ('foot') is not assumed to be a non-sortal/non-individual classifier, pairs of shoes would have to be considered atoms of the predicate *hakimono* ('footwear'), while individual shoes are atoms of the predicate *shoe*, an assumption that seems quite counter-intuitive to the atom-based analysis of counting given it opens up the possibility for there to be 'atoms' based on functional properties rather than their stability. It is unclear how 'atoms' could be defined in terms of functional properties in the analyses of Chierchia (2010, 2015) so it seems most likely that *soku* ('foot') would have to be polysemous, rather than explicitly making reference to atomic feet.

With respect to infelicity with *nan-byaku-to-iu*, Chierchia (2015) provides no means of accounting for nouns that refer to collections of individuals but nevertheless pattern like nouns that refer to undifferentiated stuff. In Chierchia's (2015) analysis, sensitivity to whether or not nouns denote stable atoms could account for the (in)felicity patterns of a majority of nouns, but it is not clear how nouns like *dōgu* ('tools') might be accounted for in this approach given it patterns with nouns that denote unstable individuals. It could be the case that mass nouns in classifier languages denote singleton properties as is assumed to be the case in number marking languages like English, thereby allowing lexical choice and object mass nouns in classifier languages, though

it is unclear what would motivate this shift given unmarked nouns are not assumed to be singular, on the contrary they are assumed to be number neutral, and therefore it is assumed that there is not an atomicity requirement in classifier languages. The existence of object mass nouns in classifier languages, therefore, present a quite difficult challenge to account for in analysis like that of Chierchia (2015).

This is not to say that an analysis like that of Chierchia (1998a, 2010, 2015) must be fully rejected. In particular, by assuming that all nouns in the lexicon are encoded as referring to kinds, Chierchia (1998a, 2010, 2015) is able predict certain characteristics of classifier languages such as a lack of an indefinite article, a lack of a definite article, a lack of obligatory number marking, and the occurrence of bare nouns. These are quite desirable predictions given they are true of classifier languages like Mandarin and Japanese. An analysis of classifier languages might therefore begin with the assumption that nouns are encoded as referring to kinds but make more room for a grammaticized lexical mass/count distinction among nominal predicates.

7.5.2 Rothstein (2010, 2017)

Given Rothstein (2010, 2017) largely follows the analysis of classifier languages of Chierchia (1998a), her analysis encounters the same challenges as his with respect to the data from Sudo (2015). Determiners that show sensitivity to individuated entities could be encoded with sensitivity to natural atomicity in her analysis. The possibility of object mass nouns poses a problem for Rothstein (2010, 2017) because it is unclear how they might be distinguished from object denoting nouns that are felicitous with count determiners like *nan-byaku-to-iu* ('hundreds of'). Because all nouns are mass in classifier languages in Rothstein's (2010) analysis, and, therefore, all object denoting nouns are object mass nouns, the only way to distinguish between nouns those that can occur with, e.g. *nan-byaku-to-iu* ('hundreds of'), and those that cannot is via indexing with a counting context. Object denoting nouns that compose with count determiners would therefore have to be shifted to a count interpretation while object denoting nouns that do not compose with count determiners would have to remain unshifted. As with the analysis of the mass/count distinction in number marking languages, what would be absent from this analysis would be an explanation of why particular nouns become count while others do not, and specifically in respect to classifier languages, there would need to be an explanation of why nouns cannot be shifted to compose with numericals.

The analysis of Mandarin classifiers argued for by Rothstein (2017) is very different from that of Chierchia (1998a, 2010, 2015) and Cheng and Sybesma (1998, 1999) in the sense that Rothstein (2017) argues there is no mass/count distinction at the level of classifiers. Rothstein (2017) argues this point with evidence from a much broader data set than that of Chierchia (1998a, 2010, 2015) and Cheng and Sybesma (1998, 1999), namely with evidence of group classifiers like *qun* (CL_{group}), partition classifier like *kuai* (CL_{piece}), and container classifiers like *píng* (CL_{bottle}) all patterning morphosyntactically with strictly individual classifiers like *ge* ($\text{CL}_{general}$). Rothstein (2017) argues, with this data, that individual classifier + noun constructions is too heterogeneous of a class to be identified as 'count', while Chierchia (1998a, 2010, 2015) and Cheng and Sybesma

(1998, 1999) have claimed that the distribution of individual classifiers substantiates a mass/count distinction in Mandarin though not among nouns.

What is unclear in Rothstein's (2017) analysis is why heterogeneity should be taken as an argument against a mass/count distinction at the classifier level. If the same argument were made for nouns in English, it is possible that one might conclude that there is no set of count nouns in English. Corresponding to categories of classifiers that have both individual (count) and measure (mass) readings in Mandarin are categories of nouns in English with members that get both count and mass readings. Corresponding to group classifiers like *qun* (CL_{group}) in Mandarin are group nouns in English, which have also been referred to as *committee* nouns or *collective* nouns, (e.g. Joosten 2003; Joosten et al. 2007, and references therein). This class of nouns includes *committee, team* and *herd*, and unlike count nouns like *chair* or *person* can get both singular and plural agreement (Quirk et al. 1985). Moreover and more importantly, there are nouns that might be considered part of this class that can be used as both mass and count, for example, *infantry* which, like a mass noun can be used as a bare singular argument, (7.41), and like a count noun can straightforwardly take plural morphology, (7.42).

(7.41) Wars can not be one on the cheap without infantry. (COCA)

(7.42) When Needham sounded the alarm, the sentinels and their infantries flooded the offices of their representatives with vitriol. (COCA)

Corresponding to partition classifiers like *kuai* (CL_{piece}) in Mandarin, which can be used to talk about a whole or parts thereof, are homogeneous nouns in English like *fence* and *hedge*, which can also be used to refer to a count whole or parts thereof (Krifka 1989; Gillon 1992; Rothstein 2010, 2017, among others), and like mass nouns, they can occur bare in pseudo-partitive (measure) DPs (Filip and Sutton 2017). Corresponding to container classifiers like *píng* (CL_{bottle}) in Mandarin which get both individual and non-individual readings are dual-life nouns like *stone, rope* and *hair* in English which also get individual and non-individual uses. While the behavior of these classes of Mandarin constructions and English nouns are not identical, this comparison shows that these categories of nouns in English have diverse characteristics much like the set of individual classifier + noun constructions in Mandarin. Applying Rothstein's (2017) argument that heterogeneity among individual classifiers in Mandarin prevents a mass/count distinction from existing at this level, one might likewise argue that the heterogeneity among nouns in English prevents a mass/count distinction from existing at the nominal level. The fact that Rothstein (2010, 2017) herself is a champion of a lexically based/mass count distinction in English calls into question her assumption that the heterogeneity in Mandarin prevents any classification of count and mass, while the heterogeneity of nouns in English does not put into question whether or not English has a mass/count distinction. In summary, Rothstein's (2010; 2017) analysis of classifier languages makes predictions that are too weak to account for nouns with the characteristic properties of object mass nouns, and the claim that classifier languages could not be said to have a mass/count distinction at the classifier + noun level seems to conflict with her claim that English has a *bona fide* lexical mass/count distinction at the nominal level.

7.5.3 Sudo (2016, 2015)

Though Sudo (2016) does not presuppose any existing analysis of the mass/count distinction, he does assume that countable nouns like *hana* ('flower') denote non-overlapping atoms. It might be possible, then, that Sudo's (2016) analysis of classifiers in Japanese could be extended to account for object mass nouns in Japanese by assuming an analysis of the mass/count distinction like that of Landman (2016) or Sutton and Filip (2016b,c, 2018, 2019) and Filip and Sutton (2017). Potential object mass nouns like *shokki* ('dishware') could be assumed to denote sets of overlapping atoms in these analyses where atom is assumed to mean something like countable individual rather than semantic atom given these analyses of the mass/count distinction assume a non-atomic mereology. Unlike Chierchia (1998a, 2010, 2015) and Rothstein (2010, 2017), however, the analysis of Sudo (2016) does not predict a lack of an indefinite article, a lack of a definite article, a lack of obligatory number marking, and the occurrence of bare nouns.

7.5.4 Erbach et al. (2017)

The non-disjointness based analysis of nominal predicates argued for in Erbach et al. (2017) is based on the analysis of Sutton and Filip (2016b,c) and Filip and Sutton (2017), and it is straightforwardly able to account for the presence of object mass nouns in Japanese, though like Sudo (2016), this analysis alone provides no means of accounting for the fact that there is a lack of definite and indefinite determiners or the fact that bare nouns occur freely. As mentioned at the beginning of this section, this account, like all others face a challenge in accounting for determiners that require, allow, or prohibit classifiers. One means of accounting for all of these phenomena might be to assume, like many others, that nouns are encoded as kinds thereby accounting for the lack of definite and indefinite determiners, accounting for the fact that bare nouns occur freely, and having an easier means of accounting for the selectional restrictions of determiners. Accounting for the behavior of object mass nouns would still be possible if determiners like *nan-byaku to iu* ('hundreds of') are assumed to combine with nominal predicates rather than kinds, and that nominal predicates in Japanese follow the analysis proposed by Sutton and Filip (2016b,c, 2018, 2019) and Filip and Sutton (2017) as applied to Japanese by Erbach et al. (2017).

7.6 Implications from the discussion of Japanese

As has been widely discussed and further documented in this chapter, the characteristics of the nominal systems in classifier languages are very different from those in number marking languages like English. As pointed out by Chierchia (1998a), all nouns can occur bare in classifier languages, rather than just mass nouns and plural nouns as in English, there is a general lack of plural morphology, definite, and indefinite articles in classifier languages, all of which are obligatory in English, and classifiers are required for counting all nouns in classifier languages but are only required for counting mass nouns in English. At the same time, however, Sudo (2015) shows that Japanese is not entirely distinct from languages like English, because both contain a system

of determiners that are sensitive to the lexical properties of nouns. In particular, large round numericals and five determiners exhibit the sort of semantic sensitivity that is characteristic of count determiners in languages with a grammaticized lexical mass/count distinction. In summary, while classifier languages are distinct from number marking languages in many respects, Japanese nevertheless has some of the key properties of number marking languages as well, which means that classifier languages are typologically less distinct from number marking languages than has been previously believed.

Chierchia (1998a) shows that many of the characteristics of classifier languages are predicted in an analysis of classifier languages that assumes nouns denote kinds. For example, a lack of an indefinite article, a lack of a definite article, a lack of obligatory number marking, and the occurrence of bare nouns are all predicted when nouns are assumed to denote kinds and therefore able to occur bare. What is not predictable in an analysis like that of Chierchia (1998a, 2010, 2015) or Rothstein (2010, 2017), where all nouns are of the same semantic type with respect to countability, is the sort of behavior exhibited by object mass nouns, namely grammatically patterning unlike nouns that refer to discrete individuals but like nouns that refer to undifferentiated stuff. In this thesis I have shown that there is reason to believe that Japanese has two-to-six, and possibly more, nouns that refer to objects but grammatically pattern like nouns that refer to undifferentiated stuff. In exhibiting these properties, it can be said that certain Japanese nouns have characteristic properties of object mass nouns, while other nouns that refer to objects do not. Analyses in which mass/count reflexes in classifier languages are reduced to the substance/object distinction are unable to account for the behavior of a unique set of object mass nouns because all object denoting nouns are predicted to behave identically. Similarly, analyses of object mass nouns in which they are treated as the result of number marking being defined in terms of stable atomicity (Chierchia 2010, 2015) have no means of accounting for how object mass nouns might arise in a classifier language given they generally lack number marking.

As has been argued throughout this thesis a non-disjointness based analysis of countability like that in Sutton and Filip (2016b,c, 2018, 2019) and Filip and Sutton (2017) can account for object mass nouns across languages, and this has been demonstrated once again in Japanese, by Erbach et al. (2017). However, this sort of analysis cannot predict other characteristics of classifier languages such as a lack of an indefinite article, a lack of a definite article, a lack of obligatory number marking, and the occurrence of bare nouns. The most comprehensive analysis of nominal systems would therefore find some way to combine the two approaches to classifier languages—the kind based analysis, and the non-disjointness based analysis of counting—and such a synthesis of analyses will be discussed further in the subsequent chapter.

This investigation into the Japanese nominal system seems to show that Japanese has few object mass nouns and relatively few morphosyntactic environments sensitive to the countability of nouns. The research described in this thesis gives reason to believe that two nouns and possibly even six or more have the characteristic properties of object mass nouns. Exhibiting the object mass properties of these nouns is possible with at least two of the six morphosyntactic environments that Sudo (2015) shows are sensitive to the countability of nouns in Japanese. The low number of object mass nouns and morphosyntactic environments sensitive to the countability of nouns

in Japanese supports the main hypothesis of this thesis that there is a relationship between the number of object mass nouns and the number morphosyntactic environments sensitive to the countability of nouns in a given language.

Chapter 8

Conclusion

This thesis has explored the extent to which object mass nouns constitute a testing ground for theories of the mass/count distinction, as initially proposed by Chierchia (2010) in the quote at the start of this thesis, and in doing so has motivated the main hypothesis of this thesis, namely that the number of object mass nouns in a language corresponds to the number of morphosyntactic environments sensitive to the countability of nouns in that language. This chapter concludes this thesis by first summarizing both the evidence of object mass nouns in Greek, Hungarian, and Japanese, and the theoretical predictions that the presence of object mass nouns in these languages cast doubt on. This review also serves to illustrate the ways in which the mass/count distinctions in Greek, Hungarian, and Japanese vary from one another and English. The variance we see is that English exhibits the largest number of mass/count properties—i.e. types of morphosyntactic environments sensitive to the countability of nouns, though this number decreases across Greek, Hungarian, and Japanese respectively. We also see that, separate from the number of mass/count properties, Greek, Hungarian, and Japanese have relatively few object mass nouns, while English has relatively many morphosyntactic environments sensitive to the countability of nouns and likewise relatively many object mass nouns. This data supports the main claim this thesis, namely that the number of object mass nouns in language corresponds to the number of morphosyntactic environments sensitive to the countability of nouns in that language.

Looking beyond the claim that the number of object mass nouns in language corresponds to the number of morphosyntactic environments sensitive to the countability of nouns in that language, in this chapter I will discuss the extent to which this correspondence might be a causative relationship predictable in different theories of the mass/count distinction. I also address outlying data from classifier languages and quantity comparison tasks that are not accounted for with a purely non-disjointness based analysis of the mass/count distinction, and propose means by which all of the data might be accounted for under a single analysis. The final section takes stock of the theories, data, and contributions of this thesis.

8.1 Analyses, predictions, and mass/count distinctions

Looking at the analyses of the mass/count distinction, the predictions regarding object mass nouns that follow from these analyses, and the mass/count properties in Greek, Hungarian, and Japanese has shown that none of the analyses capture all of the relevant data, though a non-disjointness based analysis best predicts when and where object mass nouns might arise inter- and intra-linguistically. The analyses of Chierchia (2010, 2015) predict that object mass nouns should not arise in Greek and Japanese because neither of these languages have number marking like that in English, which is assumed to be defined in terms of stable atoms and assumed to be the underlying source of object mass nouns. The analysis of Rothstein (2010, 2017) predicts that object mass nouns should be able to occur among all nouns that denote objects, or natural atoms, though this is not what has been seen across English, Greek, Hungarian and Japanese, even in the two languages in which (almost) all nouns that refer to objects have the mass noun property of being counted with classifiers. Instead, what we see in these languages is that object mass nouns tend to arise within a certain category of object denoting nouns, namely those that refer to collections of individuals that can denote non-disjoint individuated entities. The non-disjointness based analysis of Sutton and Filip (2016b,c, 2018, 2019) and Filip and Sutton (2017) predicts that object mass nouns should only be able to occur among nouns that denote individuated entities that are non-disjoint at the null counting schema. The presence of object mass nouns that behave distinctly from all other nouns that refer to objects in Greek, Hungarian, and Japanese respectively is evidence against the theories of the mass/count distinction argued for by Chierchia (2010, 2015) and Rothstein (2010, 2017). In other words, it does not seem to be the case that a lack of number marking defined in terms of stable atoms means there are no object mass nouns in Greek or Japanese (contra Chierchia 2015), and it does not seem to be the case that the fact that a noun can be counted with a classifier means that this noun has an object mass denotation in Hungarian or Japanese (contra Rothstein 2010, 2017). Instead of seeing no object mass nouns in Greek or Japanese, or seeing many object mass nouns in Hungarian and Japanese, what we see is that these languages have at least a few nouns with characteristic properties of object mass nouns. In this section I review analyses of the mass/count distinction, the predictions they make with respect to certain languages, and the data in these languages that either contests or supports a given analysis.

With respect to Greek, there have been two different approaches to capturing this language's characteristics with a semantic account of the mass/count distinction, namely the approach of Tsoulas (2008) and Chierchia (2015), in which number marking is defined such that it predicts there are no object mass nouns in Greek, and the approach of Erbach (2019), in which the theory of the mass/count distinction by Sutton and Filip (2016b,c) and Filip and Sutton (2017) is applied to Greek and extended with a modified version of the theory of plurality from Grimm (2013). The analyses of Tsoulas (2008) and Chierchia (2015) require modifications to their theories of the mass/count distinction in Greek in order to account for the data that suggests Greek has at least two object mass nouns. This thesis has also shown that the theory of the mass/count distinction in Sutton and Filip (2016b) and Filip and Sutton (2017) can be applied to Greek, thereby accounting for the existence of object mass nouns, though accounting for the nature of number marking requires the incorporation of a theory of number marking in Greek like

that of Kane et al. (2015) or Erbach (2019). The presence of object mass nouns in Greek has therefore revealed which theory of the mass/count distinction requires changes to the fundamental assumptions in order to account for the relevant data (namely, the theories of Tsoulas 2008; Chierchia 2015), and which makes assumptions that require no changes, though must be extended with additional assumptions (namely, the theory of Sutton and Filip 2016b; Filip and Sutton 2017).

Hungarian has also been analyzed with respect to two different theories of the mass/count distinction, namely that of Rothstein (2010), as applied by Rothstein (2017) and Schvarcz and Rothstein (2017), and that of Sutton and Filip (2016b) and Filip and Sutton (2017), as applied by Erbach et al. (2019). This thesis has shown that, while both analyses are able to capture the behavior of the three Hungarian nouns that seem to be strictly object mass, it is unclear how Rothstein (2017) and Schvarcz and Rothstein (2017) would account for the fact that the nouns that they claim to be dual life display distinct behavior from another, smaller set of nouns that display dual life behavior in a larger number of morphosyntactic environments. The approach taken by Erbach et al. (2019) does not assume that all countable nouns are dual life in Hungarian, rather they apply the theory of the mass/count distinction from Sutton and Filip (2016b) and Filip and Sutton (2017) to Hungarian with the assumption that singular nouns are number neutral. This thesis has shown that the theory of the mass/count distinction by Sutton and Filip (2016b,c) and Filip and Sutton (2017) can account for the distribution of nouns across classes and morphosyntactic environments, though requires extension to account for plurality and modification to account for the fact that classifiers can occur between determiners and nouns. Looking at nouns claimed to be object mass in Hungarian by Rothstein (2017) and Schvarcz and Rothstein (2017) has shown that the prediction regarding which nouns can be object mass by Rothstein (2010) is too weak, while that of Sutton and Filip (2016b) and Filip and Sutton (2017) is accurate.

Classifier languages have been analyzed with respect to a number of different theories of the mass/count distinction, and this thesis addressed those of Chierchia (1998a, 2010, 2015), Rothstein (2010, 2017), and that of Sutton and Filip (2016b) and Filip and Sutton (2017) as applied to Japanese by Erbach et al. (2017) among others. The approaches of Chierchia (1998a, 2010, 2015) and Rothstein (2010, 2017) have no means of accounting for a set of two-to-six object mass noun in Japanese that shows distinct behavior from all other nouns that refer to objects. At the same time, Erbach et al. (2017) have shown that assuming that count determiners are sensitive to disjointness in nominal predicates as analyzed by Sutton and Filip (2016b,c) and Filip and Sutton (2017) provides a means for accounting for object mass nouns and the distribution of nouns with count determiners in Japanese. This latter approach does not straightforwardly predict other characteristics of classifier languages, such as freely occurring bare nouns and a lack of definite and indefinite determiners, unlike the analyses of Chierchia (1998a, 2010, 2015) and Rothstein (2010, 2017). This thesis has shown that the presence of a distinct class of object mass nouns in Japanese requires significant changes to some theories of the mass/count distinction as applied to classifier languages (e.g. Chierchia 1998a, 2010, 2015; Rothstein 2010, 2017), while other theories capture the behavior of nouns (i.e. Sutton and Filip 2016b; Filip and Sutton 2017), but their application to Japanese (i.e. Erbach et al. 2017) requires modification to also account for the distribution of classifiers.

Summarizing the data discussed in English, Greek, Hungarian, and Japanese, it is possible to view these languages in such a way that they seem to constitute a continuum between what we might call transparent mass/count languages and opaque mass/count languages. A language that is a transparent mass/count language makes its mass/count distinction very clear by having many mass/count properties, or types of morphosyntactic environments sensitive to the countability of nouns. A language that is an opaque mass/count language has a mass/count distinction that is very hard to uncover given it has very few (types of) morphosyntactic environments sensitive to the countability of nouns. The most transparent mass/count language discussed in this thesis would be English given it displays the largest number of mass/count properties: determiners that select only count nouns (DET_{count}), numericals that directly combine with count nouns (NUM+N), semantically plural count nouns that correspond to morphologically plural count nouns (*N_{count} →N.PL), and the presence of mass determiners (DET_{mass}). Greek, Hungarian, and Japanese respectively manifest fewer and fewer of the properties of the mass/count distinction, and therefore are less transparent and more opaque in the way they manifest the mass/count distinction. It should be noted that, while Hungarian has plural morphology, on the number neutral analysis of singular count nouns in Hungarian (Farkas and de Swart 2010; Erbach et al. 2019), it is not the case that semantically plural count nouns always correspond to a morphologically plural count noun. Japanese lacks the same mass/count properties as Hungarian, namely a mass determiner and semantically plural count nouns being morphology plural, but the mass/count distinction in Japanese is even less transparent than that in Hungarian in that numericals generally cannot occur directly with nouns, though there are exceptions as noted by Sudo (2015). A summary of how these properties of are manifested in the languages investigated in this thesis is given in Table 8.1, where present properties are marked with ✓, present but restricted properties are marked with ✓-, and non-existent properties are marked with ×.

Table 8.1: Comparison of Mass/Count Properties across Languages

Language	DET_{count}	NUM+N	*N_{count} →N.PL	DET_{mass}
English	✓	✓	✓	✓
Greek	✓	✓	✓	×
Hungarian	✓	✓	×	×
Japanese	✓	✓-	×	×

This table reveals that the manifestation of mass/count properties varies in two ways. First, the manifestation of a single property can be graded: while count nouns can always combine directly with numericals in English, Greek, and Hungarian, this is not the case in Japanese, where such composition is much more restricted. Rather than either having a property or not, the restrictions on numerical+noun composition in Japanese shows that the manifestation of these properties can be graded rather than strictly occurring or not. It is unclear if this variation is free or whether there are constraints on the ways in which realizations of mass/count properties vary. Second, rather than certain properties randomly occurring (or not) across languages, the realization of properties across languages seems to be graded as well. While English realizes the largest number of mass/count properties, Japanese realizes the smallest number of mass/count properties, only having a set of determiners that occur with count nouns (DET_{count}), and restricted numerical+noun composition. Hungarian realizes more properties of the mass/count distinction than Japanese, for example allowing direct counting (NUM+N). Greek is a little more transparent

with respect to mass/count properties than Hungarian, in that plural morphology corresponds to semantically plural nouns. The realization of properties associated with the mass/count distinction is graded in the sense that they seem to occur systematically and gradually rather than randomly—that is, it seems that if a language is going to have any property of the mass count distinction at all, it will be count determiners; if a second property is present, it might be direct counting, third plural morphology on semantically plural count nouns, and so on. Given the small number of languages considered for this study these gradients might be artifacts of the data set at hand, so further crosslinguistic research is needed to elucidate the extent to which the manifestation of the mass/count distinction can be considered a graded phenomenon and whether or not there is a hierarchical or dependency structure that determines whether or not a given property will exist.

Recall that Chierchia (1998a) characterizes the mass/count distinction in English with respect to ten properties including obligatoriness of classifier and measure phrases for combining mass nouns with numericals, determiners that occur with only count or only mass nouns, etc. Chierchia (1998a) stipulates that languages vary with respect to the manifestation of these properties, citing the differences in distribution of bare nouns in English, Spanish, and French as an example (see also Chierchia 1998b, and references therein). In accordance with his stipulation that the realization of these properties will vary from language to language, it has been seen in this thesis that not all ten of these properties are realized in languages with a mass/count distinction. For example, Greek and Hungarian are argued to have a mass/count distinction, but it seems that they lack determiners that occur only with mass nouns.

No theory of the mass/count distinction explicitly predicts the sort of gradient variation in the manifestation of properties of the mass/count distinction that is illustrated above. For Chierchia (1998a), there are only two categories of languages pertaining to realizations of the mass/count distinction: those that have a mass/count distinction (later called *number marking languages*), and those that do not (classifier languages). This categorization is extended to three in Chierchia (2010) where Dëne Sułiné (Athapaskan) stands as a case of a language with neither obligatory number marking nor obligatory classifiers (Wilhelm 2008). Chierchia (2015) discusses a different three-way distinction, namely that between number marking languages, classifier languages, and Yudja (Juruna), which does not have determiners and does not have obligatory classifiers for counting even mass nouns (Lima 2010). Schvarcz and Rothstein (2017) also present three categories of languages, where the third category, 'mixed' languages, exemplified by Hungarian, has features of both number marking languages and classifier languages. While the categorization of Schvarcz and Rothstein (2017) comes closest to the types of gradation of mass/count phenomena depicted in Table 8.1, it only hints at the degrees of variation that seem to exist across English, Greek, Hungarian, and Japanese. In other words, the analysis that put the mass/count properties of languages in opposition to one another do not do so in any way that suggests there might be the sort of gradation that is seen in Table 8.1. Furthermore, it seems that no semantic theory of the mass/count distinction predicts that such gradient should exist.

The semantic theories of the mass/count distinction addressed in this thesis have all been shown to require some sort of extension or modification to account for the behavior of object mass nouns and other phenomena in the nominal domain that have been discussed in this thesis. A

non-disjointness based theory of the mass/count distinction (Landman 2011, 2016; Sutton and Filip 2016b,c, 2018, 2019; Filip and Sutton 2017) accurately predicts that object mass nouns can occur in languages with a grammaticized lexical mass/count distinction among nouns whose set of individuated entities contains entities that are non-disjoint from one another, and to this extent, this sort of theory can account for the fact that it seems that Greek, Hungarian, and Japanese each have a class of object mass nouns distinct from other nouns that refer to objects. The theories in which object mass nouns are singleton properties (Chierchia 2010, 2015) predict that object mass nouns should not exist in languages like Greek and Japanese, and these theories assume Greek and Japanese lack number marking defined strictly in terms of stable atomicity. The presence of object mass nouns in these languages means that these theories of the mass/count distinction are too restrictive to account for all of the relevant data. Theories in which object mass nouns denote uncountable semi-lattices (Rothstein 2010, 2017) likewise cannot account for a small set of uniquely behaving object mass nouns in classifier languages because such theories predict that all object denoting nouns should be uniformly object mass, yet we have seen that this is not the case in Hungarian or Japanese, where small numbers of nouns with non-disjoint individuals in their denotations are the only nouns that exhibit object mass behavior in a number of environments. To this end, the extent to which object mass nouns constitute a good testing ground for theories of the mass/count distinction has been demonstrated with respect to analyses of Greek, Hungarian, and Japanese.

8.2 Mass/count morphosyntax and mass/count nouns

In addition to demonstrating the extent to which object mass nouns constitute a testing ground for theories of the mass/count distinction, this investigation has provided evidence in support of the novel claim that there is a relationship between the number of object mass nouns in language and the number of morphosyntactic environments sensitive to the countability of nouns in that language. The data pertaining to the mass/count distinctions in English, Greek, Hungarian, and Japanese shows a correlation between the number of object mass nouns and the number of morphosyntactic environments sensitive to the countability of nouns in a given language. While English has a relatively large number of object mass nouns (≥50, listed in the Appendix), the other languages analyzed in this thesis seem to have far fewer: Greek ≥2, Hungarian ≥3, Japanese ≥2. (Each of these numbers are listed with ≥ on the assumption that the nouns reviewed in this thesis are object mass nouns and on the assumption that further empirical research could reveal additional object mass nouns in each of these languages.) It seems there have been no large-scale empirical investigations along the lines of Allan (1980) or Kiss et al. (2016) testing the properties of nouns in Greek, Hungarian, or Japanese, leaving open the question of how many object mass nouns these languages have. The work on Japanese presented in this thesis and in Erbach et al. (2017) constitutes the beginnings of such an investigation in Japanese, having tested 45 nouns that refer to collections of individuals and therefore have the potential to be object mass. Such investigations across all languages are necessary to get a better idea of the semantic properties of object mass nouns and of the relationship between the existence of object mass nouns and the realization of mass/count properties in a given language. In the absence of such empirical work,

the findings in this thesis support the hypothesis that there is a relationship between the number of object mass nouns and the realization of mass/count properties in a given language.

English, for example, is known to have many morphosyntactic environments that are sensitive to the countability of nouns—or 'tests' for the mass/count distinction—(Chierchia 1998a, mentions at least 13), and it likewise has many object mass nouns. The tests for the English mass/count distinction from Chierchia (1998a) include numerical determiners (which I count as a single test, rather than an infinite number of tests as there are infinite numbers), straightforward number marking, obligatoriness of classifier for combining with numerical determiners, eight different count determiners, and two mass determiners. I do not assume this list is comprehensive, nor authoritative—for example, *few* and *a few*, arguably, should not be listed separately—I merely use this list for the sake of example on account of the fact that it is widely cited. These tests listed by Chierchia (1998a) that are specific to either count nouns or mass nouns are enumerated below:

1. numerical determiners
2. number marking
3. obligatory classifiers for counting
4. *a(n)*
5. *both*
6. *each*
7. *every*
8. *few*
9. *a few*
10. *many*
11. *several*
12. *little*
13. *much*

In addition to this relatively long list of tests for countability, the number of object mass nouns in English is relatively large, possibly around 50 or more. In the appendix of this thesis, I have compiled a list of potential object mass nouns, some of which have been tested for whether or not they denote objects that are sometimes semantically available—e.g. *furniture*—and some of which have yet to be tested—e.g. *traffic, mail*. In the absence of a definitive list, I use the number 50 as an approximation given some of these nouns might prove to not be object mass, and given there might be additional object mass nouns in English that simply have not yet been documented as such.

Relative to English, Greek, Hungarian, and Japanese have fewer tests for the mass/count distinction, and they likewise have fewer object mass nouns. Tsoulas (2008) only uses two tests for the mass/count distinction in Greek—numerical determiners and the count determiner *kathe* ('every')—and Alexiadou (2015) only straightforwardly calls two nouns object mass nouns in Greek. It could be that Greek has more morphosyntactic environments that uncover its mass/count distinction—Tsoulas (2008) lists seven other determiners that can take either count noun or mass determiners—but the extent to which they are acceptable with only mass or only count nouns has not been demonstrated.

For Hungarian, Schvarcz and Rothstein (2017) provide three tests for count nouns—plural morphology, direct counting, and the count WH-determiner *hány* ('how many')—and this thesis has presented one more test for count nouns—*egy pár* ('a couple of')—and has argued that Hungarian has at least three object mass nouns. This list of mass/count tests is not meant to be exhaustive or definitive for any of the above languages, rather it is meant to point at a possible avenue for further research. For example, it could be argued that both Hungarian and Greek

have indefinite determiners that can be considered tests for the mass/count distinction, however, as these indefinite determiners are identical to the numerical expression for the numeral 1—*egy* ('one' Hungarian), *enas* ('one' Greek)—it is not clear that they should be considered tests for the mass/count distinction that are distinct from counting. What remains to be shown is the extent to which unmentioned morphosyntactic environments demonstrate sensitivity to the countability of nouns and can be assumed to be tests for the mass/count distinction, and whether or not there are more nouns that exhibit grammatically mass behavior and that refer to objects that are only sometimes semantically accessible.

With respect to Japanese, Sudo (2015) observes the ability of five morphosyntactic environments to distinguish count nouns from mass nouns, and this thesis has presented data that suggests Japanese might have two, and possibly even six or more, object mass nouns. The mass/count

Table 8.2: Approximate Numbers: Tests versus Object Mass Nouns

Language	Tests	Object Mass Nouns
English	13	50
Greek	2	2
Hungarian	4	3
Japanese	5	2-6

sensitivity of nominal systems in Greek, Hungarian, and Japanese have not be subject to several decades of scrutiny, as has been the case for English, and therefore it might be the case that these numbers are artificially low. At the same time, however, the number of tests in English might likewise be considered to be low given it does not include several determiners—*another*, *either*, and *neither*—which presumably only occur with singular count nouns, nor does the list include the plural demonstrative determiners *these* and *those*, which presumably only straightforwardly occur with plural count nouns. Additionally excluded are counting phrases like *a number of*, *a couple of*; *a pair of, pairs of*; *a dozen, dozens of*; *hundreds of*; *thousands of*; etc., which also presumably only straightforwardly occur with count nouns. Assuming the number of tests in English is 13 is therefore also assuming an artificially low number, given the additional tests discussed here could raise the number significantly. It is therefore quite likely that the numbers of tests for countability in English, Greek, Hungarian, and Japanese are all higher than assumed to be the case here, and further research is needed to see exactly how much higher these numbers go in each language.

The existing research across these languages shows a tendency for languages with more morphosyntactic environments sensitive to the mass/count distinction to have more object mass nouns, and vice versa. In lieu of more extensive research, the existing data supports, at weakest, the conclusion that there is a correlation between the number of object mass nouns and the number of morphosyntactic environments sensitive to countability in a language, and at best, the conclusion that the number of object mass nouns depends on the number of morphosyntactic environments sensitive to countability in a language.

Comparing the number and kinds of tests for the mass/count distinction across English, Greek, Hungarian, and Japanese shows that the number of tests, and perhaps also the kinds of tests, correlates with the number of object mass nouns in a given language. In addition to having few

object mass nouns and few tests for the mass/count distinction, Greek, Hungarian, and Japanese also seem to lack a dedicated mass noun determiner along the lines of *much* in English. Lacking a mass determiner seems to go hand in hand with having relatively few tests for the mass count distinction and likewise with having few object mass nouns. This is direct evidence in support of the view that the number of object mass nouns in a given language is related to the amount of morphosyntax sensitive to the countability of nouns in that language. This suggests that there is a more complex and nuanced relationship between object mass nouns and morphosyntactic environments than originally proposed by Chierchia (2010, 2015). Rather than a single feature being the deciding factor in whether or not a language has object mass nouns, what seems like it could be the case given the data presented here is that there is a relationship between the number of object mass nouns in a language and the number of morphosyntactic environments sensitive to the countability of nouns in that language.

While the discussion so far has been framed largely in terms of the number of distinct countability tests in a given language, another factor, and perhaps a more important factor, might be the frequency of use of these distinct countability tests when it comes to determining the number of object mass nouns. With respect to frequency, the fact that I have grouped all numerical determiners into a single morphosyntactic test means that this test and any other test, for example the mass determiner *little*, could be interpreted as having the same impact (or weight) on the number of object mass nouns in a language. However, we might also want to consider the frequency of occurrence of these different tests as a factor in determining the number of object mass nouns a language is likely to have given English numerical determiners are likely used much more frequently than the mass determiner *little*. Investigating the relative frequency of these countability tests could shed further light on how likely it is that a language has a small or large number of object mass nouns.

What also remains to be seen is whether or not there is a weighting of certain mass/count properties that affects the relationship between the number of object mass nouns and the number of morphosyntactic environments sensitive to the countability of nouns in a language. For example, the graded transparency of mass/count properties in Table 8.1 might correspond to some sort of weighting that causes there to be many more object mass nouns in English than in Greek, Hungarian, and Japanese. Other factors that might influence these numbers include the frequency of use of these mass/count properties, the frequency of use of different nouns whose set of individuated entities is non-disjoint, the size of the lexicons in the respective languages, and perhaps even the availability of derivational morphology such as that argued by Alexiadou (2015) to create object mass nouns in Greek, or the suffixes *-ware* and *-wear* in English. Further research on these properties of the mass/count distinction are needed to refine the hypothesis motivated here that there is a relationship between the number of object mass nouns and the number of morphosyntactic environments sensitive to the countability of nouns in a language.

One hypothesis based purely on the number and frequency of morphosyntactic environments sensitive to the countability of nouns in a language would suggest that English should at least have a stable class of object mass nouns while Greek, Hungarian, and Japanese might not have a stable class of object mass nouns. If a language has many frequently occurring morphosyntactic environments that are sensitive to the countability of nouns, then learners of that language

will frequently be exposed to information that indicates the countability of any given noun. In other words, there is a high probability that a randomly chosen sentence in that language will have information that pertains to the countability of the noun(s) in that sentence and that information will be used by learners to encode nouns as count or mass. For example, if a language learner believes that a noun is, say, mass, then that hypothesis will be validated or invalidated by the sentences containing that noun, a large number of which will contain information about the countability of that noun. Speakers will then converge on a set of implicitly agreed upon object mass nouns because information pertaining to countability is so frequent in that language. Alternatively, if a language has very few and infrequently occurring morphosyntactic environments sensitive to the countability of nouns, then there will be little information for a language learner to validate or invalidate hypotheses about the countability of certain nouns. A language learner may believe a particular noun is, for example mass, but there will be few sentences containing information about whether or not other speakers also consider that noun to be mass, because there are relatively few morphosyntactic environments sensitive to the mass/count distinction in this other language, and those that do exist are relatively uncommon. In such a language speakers will only have equivalent sets of object mass nouns by chance because of the scarcity of information pertaining to a noun's countability.

This hypothesis seems to be borne out across English and Japanese. In English, a large number of frequently occurring morphosyntactic environments sensitive to the countability of nouns exists alongside a stable set of object mass nouns. In Japanese on the other hand, a small number of morphosyntactic environments sensitive to the countability of nouns exists and may very well be infrequently occurring alongside a small number of nouns that seem to have the properties of object mass nouns, though grammaticality judgments do not strongly converge on one agreed upon countability encoding across speakers. The data from Japanese in Chapter 7 shows that there is a degree of variation in how speakers judge object mass noun candidates in morphosyntactic environments that select for count nouns: while some object mass noun candidates strongly pattern with count nouns, and others strongly do not pattern with count nouns, there are several object mass nouns that do not strongly pattern with either group with respect to felicity with the count determiner *nan-byaku to iu* ('hundreds of'). This language learning based hypothesis seems to align with the fact that English has a stable set of object mass nouns, while Japanese, on the other hand, does not seem to have a set of object mass nouns that get robust infelicity judgments with respect to composition with the determiner *nan-byaku to iu* ('hundreds of'). What remains to be seen is why it should be the case that the number of object mass nouns should correspond to the amount of mass/count morphosyntax. Though this learning based hypothesis does not provide any insight on the number of object mass nouns in a given language, it nevertheless serves to illustrate the sort of relationship that may shape the possible correlation between the between the number (and frequency) of morphosyntactic environments sensitive to the countability of nouns and the number of object mass nouns in a language.

Though the analysis of Chierchia (2010, 2015) assumes that there is a relationship between one particular morphosyntactic environment sensitive to the mass/count distinction and whether or not a language has object mass nouns, several other analyses make different predictions about which classes of nouns will or will not be expected to exhibit variation in which nouns are mass or count. While these predictions are not necessarily in direct competition, the latter mitigate the

surprise at finding data that is exceptional with respect to the rule proposed in Chierchia's (2010; 2015) analysis. Barner and Snedeker (2005), for example, argue that superordinate terms for groups of entities that occur in close spatiotemporal proximity to each other are susceptible to being object mass nouns, Sutton and Filip (2016b) argue that nouns that mass/count variation is to be expected among nouns that denote non-disjoint individuated entities at the null counting schema, and Grimm and Levin (Submitted) argue that object mass nouns are those that refer to artifacts and are interpreted with respect to associated events that typically require multiple participants. In one sense, the predictions of Barner and Snedeker (2005), Sutton and Filip (2016b), and Grimm and Levin (Submitted) could work in tandem with the theory proposed by Chierchia (2010, 2015): his analysis would predict which languages can have object mass nouns, and the other analyses predict which kinds of nouns can be object mass. Alternatively, the predictions of Barner and Snedeker (2005), Sutton and Filip (2016b), and Grimm and Levin (Submitted) could be taken to mean that it should be no surprise that small classes of object mass nouns are found in typologically distinct languages, like Greek, Hungarian, and Japanese, contra Chierchia (2010, 2015) and Rothstein (2010, 2017) whose analyses do not predict that there should be a class of object mass nouns that behave distinctly from other object denoting nouns in classifier languages.

It is unclear how theories that do not base countability in non-disjointness might account for the number of object mass nouns in English, versus Greek, Hungarian, and Japanese. As has been discussed in previous chapters of this thesis, the theories of Chierchia (1998a, 2010, 2015) and Rothstein (2010, 2017) provide a means of capturing several mass/count phenomena, though they provide no means of predicting which sort of nouns could or should be object mass, because, in languages like English, they leave whether or not any given object denoting noun is object mass up to lexical choice rather than restricting this choice to nouns that denote non-disjoint individuated entities if interpreted at the null counting schema, as argued by Sutton and Filip (2016b,c, 2018, 2019) and Filip and Sutton (2017). Rothstein (2010, 2017) allows for any noun to be count or mass depending on whether or not the noun is indexed to a counting context, and though this allows for languages like Japanese, in which she assumes all nouns are mass when predicates, there is no means of explaining why any noun should be count or mass in a given language. Chierchia (2015) straightforwardly predicts that object mass nouns should not arise in Greek or Japanese because the number marking (or lack thereof) in these languages do not require that singular nouns refer to atoms, and therefore the lexical choice that gives rise to object mass nouns does not occur. Without also appealing to notions like overlap as done by Landman (2011, 2016), Sutton and Filip (2016b, 2018, 2019), and Filip and Sutton (2017) or objects with high spatiotemporal contiguity as done by Barner and Snedeker (2005), there is no means of explaining why a noun that refers to objects might be encoded as object mass in the analyses of Chierchia (1998a, 2010, 2015) and Rothstein (2010, 2017), let alone why English seems to have many object mass nouns, while Greek, Hungarian, and Japanese seems to have relatively few. In summary, while certain theories accurately predict which kind of noun should be expected to be object mass (Sutton and Filip 2016b,c, 2018, 2019; Filip and Sutton 2017), no semantic theory of the mass/count distinction seems to predict that there should be a relationship between the number of object mass nouns in a language and the number of morphosyntactic environments sensitive to countability in that language. What might provide insights into this apparent relationship is

examining a larger set of features, such as frequency and kind of morphosyntactic environments sensitive to countability.

8.3 Outlying data

Throughout this thesis, I have argued in favor of a non-disjointness based analysis of the mass/count distinction on the grounds that it best captures the type of variation between mass and count nouns that we see across languages, particularly with respect to the set of nouns that have the potential to be object mass. While the data from Greek, Hungarian, and Japanese support this analysis, there is some outlying data that has been discussed in this thesis that cannot be accounted for with a non-disjointness based analysis of the mass/count distinction. The properties of classifier languages and the data pertaining to quantity comparison tasks from Grimm and Levin (Submitted) constitute the outlying data that cannot be accounted for on the analysis argued for in this thesis. In this section, I review these two data points and discuss modifications that could be made to a non-disjointness based analysis of the mass/count distinction so as to account for as large a data set as possible.

Chierchia (1998a) suggested that the lack of certain mass/count properties and the presence of others in classifier languages is rooted in nouns entering the lexicon encoded as kind denoting in these languages. For example, a general lack of definite determiners and lack of obligatory plural morphology directly follow from the assumption that nouns denote kinds in classifier languages, and this assumption also gives a straightforward explanation for the presence of classifiers that has been assumed in many subsequent analyses (Chierchia 2010, 2015; Rothstein 2010, 2017; Landman 2011, among others). Though it is unclear how such a prediction would be upheld while also accounting for the mass/count properties that Japanese has been shown to exhibit in Chapter 7, theories of the mass/count distinction that assume that nouns refer to kinds in classifier languages are advantageous in the sense that they make certain predictions accurately. Being able to make such predictions would likewise be advantageous for any theory of the mass/count distinction, for example one based on non-disjointness.

The theory of object mass nouns by Grimm and Levin (Submitted), having been recently proposed, has not been applied to several languages or extended to account for nominal composition with, for example, plural morphology, pseudo-partitive measure phrases, etc. Like non-disjointness based analyses (e.g. Landman 2011, 2016; Sutton and Filip 2016b,c, 2018, 2019; Filip and Sutton 2017) and uncountable semi-lattice theories and (e.g. Rothstein 2010, 2017), but unlike the analysis of Chierchia (2010, 2015), this associated event based analysis allows for object mass nouns to arise in any language with a grammaticized lexical mass count distinction. Rather than predicting object mass nouns should arise among nouns that denote non-disjoint individuated entities like the theories of Landman (2011, 2016) and Sutton and Filip (2016b,c, 2018, 2019); Filip and Sutton (2017), the associated event based analysis seems to allow for object mass nouns to arise among any noun that refers to artifacts, so long as those artifacts can be referred to in such a way that the associate event that is generally satisfied by more than one individual. This analysis seems like it has the potential to allow for almost any artifact noun to be object

mass, that is, if it can be associated with an event that typically requires multiple participants. In this sense, the analysis of Grimm and Levin (Submitted) allows for more nouns to be object mass than only those that refer to non-disjoint sets of individuated entities at the null counting schema as predicted by Sutton and Filip (2016b,c, 2018, 2019); Filip and Sutton (2017). At the same time, it is not clear if all artifact nouns could be associated with events that typically require multiple participants, and in this sense the analysis of Grimm and Levin (Submitted) does not seem to predict that all artifact nouns should be able to be object mass, as is predicted by Rothstein (2010, 2017). It therefore seems to be the case that the analysis of Grimm and Levin (Submitted) might predict that object mass nouns should be able to arise among more nouns than predicted by Sutton and Filip (2016b,c, 2018, 2019); Filip and Sutton (2017) but fewer than Rothstein (2010, 2017).

This thesis has shown that the predictions of a non-disjointness based theory are realized across several languages, yet more work must be done to show that the event based analysis of Grimm and Levin (Submitted) can account for as much of the data. On the other hand, the associated event based analysis of Grimm and Levin (Submitted) provides means by which quantity comparisons based on satisfaction of associated events can be accounted for while other analyses of object mass nouns do not. The next section of this chapter explores the possibility of integrating the associated event based analysis of Grimm and Levin (Submitted) with the analysis of Sutton and Filip (2019) in order to capture both the quantity comparison judgments in Grimm and Levin (Submitted) and the predictive power of the analyses by Sutton and Filip (2016c,b, 2018, 2019) and Filip and Sutton (2017).

In the following subsections, I will explore the extent to which it might be possible to integrate components from a kind-based analysis of classifier languages and an associated event based analysis of object mass nouns into a non-disjointness based analysis of the mass count distinction.

8.3.1 The properties of classifier languages

Chierchia (1998a, 2010, 2015) and Rothstein (2010, 2017) predict many characteristics of classifier languages with the assumption that nouns enter the lexicon encoded as kinds, namely a lack of obligatory plural morphology, a lack of definite and indefinite determiners, and the ability of nouns to occur bare in argument position. This analysis, assumed by Chierchia (1998a, 2010, 2015) and Rothstein (2010, 2017), also predicts that nouns compose with classifiers in order to be counted, though as has been argued by Krifka (1995); Bale and Coon (2014); Sudo (2016); Erbach et al. (2017) and Erbach et al. (2019), it can also be the case that classifiers can be treated as numerical modifiers, which allows for nouns to encode countability as has been suggested by Erbach et al. (2019) and Erbach et al. (2017) to be the case in Hungarian and Japanese respectively. This latter analysis of classifiers, while predicting that mass/count properties can be encoded in nouns in classifier languages, does not predict the additional properties of classifier languages that are predicted when nouns are assumed to enter the lexicon of these languages as kinds. To make all predictions, it would be necessary to assume that nouns enter the lexicon in classifier languages referring to kinds, but that the corresponding predicates encode countability.

Chierchia (1998b) argues that there is a correspondence between nominal predicates and kinds that suggest there are functions that allow for shifting between the two. For example, if λwDOG$_{\text{w}}$, type $\langle s, \langle e, t\rangle\rangle$, is assumed to be the property of being a dog, and if d is the dog-kind and type e, then the operation $^{\cap}$, which shifts properties to kinds, and the operation $^{\cup}$, which shifts kinds to properties, can be used to shift between the two types as in (8.1).

(8.1) $^{\cap}\text{DOG} = \text{d}$ $^{\cup}\text{d} = \text{DOG}$ (Chierchia 1998b, p. 349)

If nouns in classifier languages are assumed to be lexicalized as kind denoting in a way that can somehow be shifted to nominal predicates that encode countability as a matter of non-disjointness, e.g. those argued for in Chapter 7, then this analysis would predict that classifier languages would have bare nouns that freely occur, a general lack of definite and indefinite determiners, and a mass/count distinction that is uncovered by determiners that select nominal predicates and are sensitive whether or not the counting base of nominal predicates are disjoint. What such an analysis would require is a means of associating kind terms with their nominal predicates that encode countability. Such an analysis is proposed in Erbach et al. (2020).

8.3.2 Associated events

Another instance in which non-disjointness based analyses of object mass nouns fail to have explanatory power is the case of quantity comparison that occurs in terms of criteria unrelated to physical properties like discreteness, length, volume, etc. as shown by Grimm and Levin (Submitted) and discussed in Chapter 3 and Chapter 2. Recall that the results with respect to the test item from Grimm and Levin (Submitted) (in example (3.29) and repeated below) were such that some participants judged woman A's jewelry to be more and some participants judged woman B's jewelry to be more.

(3.29) **Goal:** Determine who has more
CONTEXT: Two women are at a gala event.
— Woman A is wearing two gold bracelets, a diamond tiara, and a ruby and emerald necklace.
— Woman B is wearing three gold rings, a pearl necklace and a silver bracelet.
QUESTION: Who has more jewelry? (Grimm and Levin, Submitted, p. 13)

Grimm and Levin (Submitted) account for these results with their analysis that object mass nouns are interpreted with respect to associated events that are satisfied by multiple entities. Woman B can be judged to have more jewelry because the combination of objects she wears can be judged to more satisfactorily satisfy the associated event, x adorns z with y in e, than that of woman A. On the other hand, Woman A could be judged to have more jewelry because the number of discrete, jewelry objects worn by woman A is higher in cardinality than that of woman B. While the analysis of Grimm and Levin (Submitted) can account for judgments based

on satisfaction of an associated event, they do not present a means by which judgments based on cardinality are accounted for.

One way in which Grimm and Levin (Submitted) might account for cardinality comparison of object mass nouns is with a cardinality scale, as proposed by Rothstein (2017) and defined in (8.2).

(8.2) A cardinality scale is an order $S_{CARD,AT} = \langle N, \geq_{\text{N.}} \mid |_{\text{AT}} \rangle$ where CARD stands for cardinality, AT is the context that determines the set of atoms, and $|\ |_{\text{AT}}$ is the function that maps x onto the cardinality of the set of atomic parts of x that are in AT.
(Rothstein 2017, p. 136)

The cardinality scale uses the measure function $|\ |_{\text{AT}}$ to determine the number of countable entities in the extension of a given noun, and could therefore be used to determine which person is wearing more jewelry in a quantity comparison task such as that in (3.29).

What might be the simplest way to account for both types of judgments of (3.29) and also account for the crosslinguistic manifestation of object mass nouns, would be to integrate the analysis of Grimm and Levin (Submitted) into the theory of countability of Sutton and Filip (2019), which builds on their analyses in Sutton and Filip (2016c,b, 2018) and Filip and Sutton (2017).

The additions that Sutton and Filip (2019) make to their previous work (Sutton and Filip 2016c,b, 2018; Filip and Sutton 2017) include a treatment of 'granular' nouns like *rice* and *lentils*, pseudo-partitive NPs formed with nouns like *bowl*, and sortal/individual classifier expressions like *grain of*. These additions also come with a shift in the formulation of lexical entries, which retain their three part structure from Filip and Sutton (2017), though are changed in terms of logical structure.

Recall from Chapter 5 that for, Filip and Sutton (2017), the lexical entry of the noun *cats* takes the form in (8.3).

(8.3) $$[\![cats]\!]^{c_i} = \lambda x.\langle {}^{*}c_i(\mathbf{IND}(\text{CAT}))(x),\ \lambda y.c_i(\mathbf{IND}(\text{CAT}))(y),\ \varnothing\rangle$$

Sutton and Filip (2019) reformulate lexical entries using a modified form of frame semantics (for the original proposal for frame semantics, see Fillmore 1976). While the lexical entry of *cats* in (8.3) is type $\langle e, \langle t \times \langle e, t\rangle \times t\rangle\rangle$, the frame semantic entry in (8.4) is type $\langle e, f\ \rangle$, which allows for easier addition and modification of information inside of a lambda expression than is allowed by more widespread formalisms. Though these frames have a complex recursive, attribute-value structure, frames can be converted into propositional logic formulae with equivalent extensions.

(8.4) $$[\![\text{cats}]\!]^{\mathcal{S}_i} = \lambda x.\begin{bmatrix} basepred = \lambda z.cat(z) \\ cbase = \lambda y.\mathcal{S}_i(\mathcal{O}(basepred))(y) \\ extn = {}^{*}\mathcal{S}_i(\mathcal{O}(cbase))(x) \end{bmatrix}$$

(Sutton and Filip 2019, p. 399)

The base predicate for *cats* contains bundles of properties (perceptual or essential) that specify cats. Part of the frame for the basic *wolf* predicate is given in (8.5).

$$\lambda x.\begin{bmatrix} \text{unit} = \lambda y.\begin{bmatrix} \text{ent\_type} = \begin{bmatrix} \text{boundedness} = mssc(y) \\ \text{behavior} = animate(y) \end{bmatrix} \\ \text{fur} = \begin{bmatrix} \text{fur} = fur\_of(y,z) \\ \text{texture} = fluffy(y) \end{bmatrix} \\ \text{sound} = \begin{bmatrix} \text{sound} = sound\_of(y) \in \{howl, growl, ...\} \end{bmatrix} \\ ... = ... \end{bmatrix} \\ \text{collection} = \lambda y.\begin{bmatrix} \text{pack} = {}^{*}\text{unit}(y) \wedge TYP(social\_unit(\uparrow(y))) \\ \text{behavior} = territorial(\uparrow(y)) \\ ... = ... \end{bmatrix} \\ \text{extension} = \text{unit}(x) \vee \text{collection}(x) \end{bmatrix} \tag{8.5}$$

(Sutton and Filip 2019, p. 392)

It is in this base predicate, that I argue the associated event argued for by Grimm and Levin (Submitted) can straightforwardly be encoded given the rich structure provided by frame semantics.

The associated event for a cup from Grimm and Levin (Submitted), given in (3.27) and repeated below, could be written as (8.6) in Sutton and Filip's (2019) frame semantics.

(3.27) $[\![cup]\!] = \lambda y[\text{ABLE}[x \text{ drinks out of } y \text{ in } e_{min}]]^{w,g,h_y,j}$

(Grimm and Levin, Submitted; p. 31)

If *cup* is interpreted relative to a world w, an assignment function g, an ordering source j, and a contextual background function h_y, then part of the entry of $[\![\text{cup}]\!]^{w,g,j,h_y}$ will be:

$$\lambda y.\exists e.\exists z.\begin{bmatrix} \text{agent} = agent(e){=}z \\ \text{eventuality} = ABLE(drink\_out\_of(y,z,e_{min})) \end{bmatrix} \tag{8.6}$$

such that $ABLE(drink\_out\_of(y,z,e_{min}))$ is true iff, given the contextually relevant properties of $g(y)$ specified by h_y, there is a world that is maximally close to the ideal satisfied by $j(w)$ in which there is a minimal drinking out of event e_{min} in which an agent drinks out of $g(y)$.

The event associated with *cup*, (8.6), can be integrated into the frame of the base predicate for *cup* as in (8.7), which also contains other properties that specify entities, each of which is bounded (in the sense of being maximally strongly self connected (Grimm 2012)), inanimate, and can be drunk out of in the sense of (8.6). The frame for the base predicate of *cup* also contains information about sums of cups such as the fact that they typically occur in matching sets.

(8.7)

$$\lambda x.\begin{bmatrix} \text{unit} = \lambda y.\begin{bmatrix} \text{ent\_type} = \begin{bmatrix} \text{boundedness} = mssc(y) \\ \text{behavior} = inanimate(y) \end{bmatrix} \\ \text{surface} = \begin{bmatrix} \text{surface} = surface\_of(y,z) \\ \text{texture} = texture\_of(y) \in \{smooth, rough, ...\} \end{bmatrix} \\ \text{event} = \exists e.\exists z.\begin{bmatrix} \text{agent} = agent(e){=}z \\ \text{eventuality} = ABLE(drink\_out\_of(y,z,e_{min})) \end{bmatrix} \\ ... = ... \end{bmatrix} \\ \text{collection} = \lambda y.\begin{bmatrix} \text{set} = {}^{*}\text{unit}(y) \wedge TYP(matching\_set(\uparrow(y))) \\ ... = ... \end{bmatrix} \\ \text{extension} = \text{unit}(x) \vee \text{collection}(x) \end{bmatrix}$$

The relevant countability related operations on the base predicate, would therefore be that in (8.8), where $\lambda z.cup(z)$ is an abbreviation for the formula in (8.7).

(8.8) $$[\![\text{cup}]\!]^{\mathcal{S}_i}, \lambda x.\begin{bmatrix} baspred = \lambda z.cup(z) \\ cbase = \lambda y.\mathcal{S}_i(\mathcal{O}(basepred))(y) \\ extn = \mathcal{S}_i(\mathcal{O}(cbase))(x) \end{bmatrix}$$

In the same way that the event associated with *cup*, argued for by Grimm and Levin (Submitted), can be integrated into the nominal frames argued for by Sutton and Filip (2019), the events associated with object mass nouns like *jewelry* and *furniture* can likewise be integrated. Such integration allows for event based criteria to contribute to the identification of entities in the extension of the lexical root. Incorporating the associated event based approach of Grimm and Levin (Submitted) in this manner enriches the nominal frames of Sutton and Filip (2019) with the information necessary for quantity comparisons based on associated events to occur. Cardinality based judgments, on the other hand, can occur with a cardinality scale, as argued for by Rothstein (2017), albeit with the necessary modifications for working within Sutton and Filip's (2019) theory. This integration also provides the associated event semantics of Grimm and Levin (Submitted) with the structure of countability from Sutton and Filip (2016b,c, 2018, 2019), which has been seen throughout this thesis to accurately predict the set of nouns from which object mass nouns are expected to arise more so than certain other analyses. The synthesis of these two analyses therefore attempts to marry the sort of semantic information that can account for certain judgments in quantity comparison tasks with the analysis of countability argued for in this thesis in order to produce a semantic account of object mass nouns that captures as much of the relevant data as possible. The event associated with nouns can be integrated into the base predicate in the analysis of Sutton and Filip (2019), and such an integration does not affect the ability of this analysis to fit with the prediction made by this thesis that the number of object mass nouns in a language corresponds to the number of morphosyntactic environments in that language that are sensitive to the countability of nouns.

8.4 Taking stock

This chapter has reviewed the data in support of this thesis' main hypothesis, namely that the presence of object mass nouns in a language is related to the number of morphosyntactic environments sensitive to the countability nouns. The different ways in which languages manifest properties of the mass/count distinction can be viewed such that languages like English and those like Japanese stand at opposing ends of a spectrum of mass/count properties that languages can exhibit thereby making the languages more transparent or more opaque with respect to their mass/count distinctions. The available data on the number of morphosyntactic environments sensitive to the mass/count distinction in English, Greek, Hungarian, and Japanese and on the number of object mass nouns in these languages suggests that there is a relationship between the two. It may be possible that relationship is some sort of correlation or possibly even causal, though further empirical research is needed in order to support such possibilities. No semantic analysis of the mass/count distinction straightforwardly predicts the variation in the manifestation of properties of the mass/count distinction or a relationship between the number of morphosyntactic environments sensitive to the countability of nouns and the number of object mass nouns in a given language. However, the non-disjointness based theory argued for by Sutton and Filip (2016c,b, 2018, 2019) and Filip and Sutton (2017) can be said to have the necessary machinery for capturing the manifestation of object mass nouns across languages. Potential drawbacks of the non-disjointness based approach to the mass/count distinction include not straightforwardly predicting the properties of classifier languages as is done by an analysis that assumes that nouns in classifier languages refer to kinds, nor does it include a means of straightforwardly accounting for quantity comparisons based on associated events. Much work is needed to show the extent to which it is possible to account for all of these characteristics of nominal systems in a cohesive manner and whether or not the hypotheses motivated here hold up across other languages.

Appendix A

List of object mass nouns in English

The following list contains nouns in English that might be considered object mass nouns. Some have been shown to be object mass by Barner and Snedeker (2005) though some require investigations with respect to quantity comparison tasks, stubbornly distributive predicates, etc.

> ammunition, apparel, armor, art, artillery, artwork, autumnwear, baggage, bakeware, beachwear, bedding, change, china, clothing, clutter, coinage, crockery, cutlery, decoration, dishware, equipment, earthenware, freight, furniture, footwear, gear, glassware, hardware, inventory, jewelry, knitwear, ladieswear, laundry, legwear, lingerie, loot, luggage, mail, menswear, merchandise, molt, outerwear, packaging, paperwork, plasticware, rigging, seating, shapewear, silver, silverware, software, sportswear, squad, staff, stock, swag, tackle, teaware, tupperware, underwear, weaponry

Below are possibly contentious contenders for object mass nouns given they display characteristics of nouns that Rothstein (2010) calls 'heterogeneous', namely the entities they refer to can be divided somewhat more arbitrarily than those refer to by object mass nouns and nevertheless remain entities in the extension of the respective predicates:

> brickwork, carpeting, drapery, fencing, foliage, garbage, housing, leatherwork, litter, lumber, masonry, metalwork, plumage, refuse, rubble, takeaway, takeout, timber, traffic, vegetation, warehousing, waste, woodwork, wreckage

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