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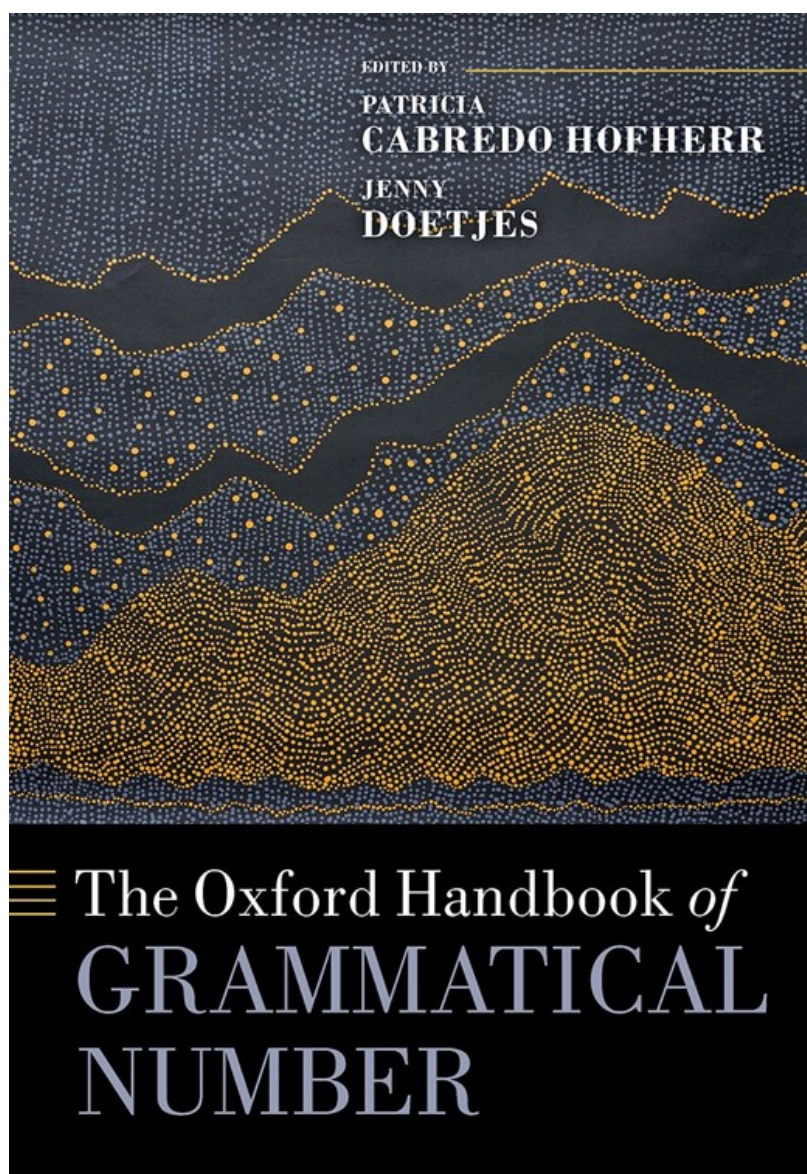
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The Oxford Handbook of Grammatical Number

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CHAPTER

4 Number and Quantity Expressions

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Abstract

This chapter examines the interactions between quantity expressions and number across languages. Quantity expressions may require the presence of specific number markers on the noun or noun phrase they combine with. They may also trigger a singular or plural interpretation for the noun phrase as a whole, as in *one N* or *several N*. An important criterion used to distinguish classes of quantity expressions is the way these expressions interact with countability. While some quantity expressions depend on the presence of countable units in order to be interpreted, others do not. Examples of the former type are numerals, vague cardinal quantity expressions (*several*), and distributive universal quantifiers (*each*, *every*), while non-cardinal quantity expressions (*a lot*) and non-distributive universal quantifiers (*all*) belong to the second category. The chapter mainly focuses on the nominal domain. The use of quantity expressions in relation to verbal plurality is considered briefly.

Keywords: cardinal quantity expressions, numerals, non-cardinal quantity expressions, universal quantifiers, distributivity, singular, plural, classifiers, mass-count distinction, individuation

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4.1 Introduction

NUMBER interacts with quantity expressions in various ways. For instance, the English quantity expression *several* is only compatible with plural count nouns, while *a lot* can also be combined with mass nouns, which cannot be pluralized:

(1)

- a. *several pens*/**water*
- b. *a lot of pens*/ *water*

The examples in (1) not only exhibit a difference in plural marking, but also in plural interpretation. Whereas *several N* necessarily has a plural interpretation, *a lot of N* does so only in the context of a plural count noun such as *pens*. The meaning of *a lot of water* is indifferent to the number of separate quantities of water that are involved: it can be used to refer to one big quantity of water or to a quantity of water that is composed of a plurality of smaller quantities. The contrast between *a lot of pens* and *a lot of water* shows that for *a lot of N* the question whether the noun phrase imposes a plural interpretation depends on the noun. In languages where grammatical number marking is absent, the second type of interaction between number and quantity expressions is usually still present; the interpretive distinction between expressions such as *several* and *a lot* can be found in many languages, independently of whether they have morphological number marking on nouns or not.

A similar distinction can be made between non-distributive and distributive universal quantifiers, which also interact with countability and number. Whereas non-distributive *all* can be used with mass nouns and with count plurals (*all pens/all water*), distributive *each* only combines with singular count nouns (*each pen*; #*each water* being only possible if *water* receives a count interpretation, such as ‘type of water’ ↯ or

‘portion of water’). Again, similar effects can be found in languages that do not have obligatory morphological number marking on nouns.

The chapter will start with a brief overview of types of constraints that are found for quantity expressions across languages (section 4.2) and an overview of the relevant semantic properties of nouns (section 4.3). This will set the scene for the main topic of this chapter: the interaction between number and quantity expressions from a cross-linguistic point of view. I will first make a distinction between cardinal quantity expressions such as *several* and cardinal numerals, which are limited to count environments, and non-cardinal quantity expressions such as *a lot*, which also occur with mass nouns (section 4.4). Then I will turn to universal quantifiers and distributivity (section 4.5). After a brief discussion of differences and similarities between nominal and verbal quantification (section 4.6), the chapter will end with an overview of the main conclusions (section 4.7).

4.2 Types of constraints on the use of quantity expressions across languages

When looking at the ways in which quantity expressions and nouns are combined cross-linguistically, three basic types of strategies can be distinguished: number marking (usually plural marking), classifier insertion, and direct combination of a quantity expression and an unmarked noun.¹ These three types of strategies are illustrated for numerals below, but they can also be found in the context of other quantity expressions. A logically possible fourth strategy consisting of the combination of numeral classifier insertion and number marking on nouns turns out to be cross-linguistically rare (see Sanches, 1971; Greenberg, 1972; Sanches and Slobin, 1973; Chapter 10 in this volume for discussion).

An example of a language in which numerals trigger obligatory number marking on nouns is English. Numerals other than *one* require plural marking on the noun (for an overview of morphological strategies for plural marking, see Chapter 7 in this volume):

(2)

two pens/*two pen

p. 67 The second strategy is classifier insertion. In numeral classifier languages such as Mandarin, all nouns that combine with numerals require insertion of a so-called numeral classifier.²

(3)

sān	*(zhī)	bǐ		(Mandarin)
three	CL _{branch}	pen	(adapted from Cheng et al., 2012: 176, (3a))	

This second strategy resembles the strategy that is used in English for mass nouns. In order to combine a mass noun such as *water* with a numeral, one has to insert a measure word. Note that with numerals other than *one* the measure word in English is normally a plural noun (e.g. *two glasses/litres of water*), so one could maintain that this is an instance of the first strategy; even though the noun cannot be pluralized, the measure word meets the plurality requirement of the quantity expression.³

It is also possible that quantity expressions do not require either number marking or classifier insertion. This third strategy can be illustrated on the basis of the Northern Athapaskan language Dëne Sųłiné, a language without nominal number marking (Wilhelm, 2008). As illustrated in (4), the numeral combines directly with a noun in the absence of a number marker or classifier:

(4)

sɔ́lághe k'ásba
five chicken
'five chickens'

(Dëne Sɔ́liné)

(Wilhelm, 2008: 40, (1a))

The three patterns illustrated in (2)–(4) are at the basis of a large amount of variation. In what follows I will first briefly indicate the main sources of variation, which will be further illustrated and elaborated on in section 4.4.

A first source of variation is the coexistence of different strategies for the same quantity expression. A well-known and often cited example of the possibility of using different strategies is Armenian (Donabédian, 1993; Sigler, 1997; Borer, 2005; Bale and Khanjian, 2014). Armenian numerals allow for all three strategies in in (2)–(4), as illustrated in (5a–c) for Western Armenian, while the combined presence of a classifier and the plural marker is prohibited (5d):

(5)

a. PLURAL MARKER

Yergu hovanoc-ner uni-m.
two umbrella-PL have-1SG
'I have two umbrellas.'

(Western Armenian)

b. CLASSIFIER

Yergu had hovanoc uni-m.
two CL umbrella have-1SG

c. NO PLURAL MARKER, NO CLASSIFIER

Yergu hovanoc uni-m.
two umbrella have-1SG

d. *PLURAL MARKER AND CLASSIFIER

*Yergu had hovanoc-ner uni-m.
two CL umbrella-PL have-1SG (adapted from Borer, 2005: 94, (6))

p. 68 Note that the example in (5c) could also be interpreted as a case of the first strategy with singular marking on the noun rather than as a case of the third strategy (absence of number marking or general number). I will come back to this below.

The possibility of using different strategies for one and the same quantity expression is quite common across languages. Numeral classifiers are optionally used in 62 out of 140 languages classified as languages with numeral classifiers in the World Atlas of Language Structures (Gil, 2005). When looking at number marking, the available data are more difficult to interpret. Restricting ourselves to the 119 languages with plural suffixes that are cited in the Atlas (Dryer, 2005; Haspelmath, 2005), the following can be observed: 72 of these languages have obligatory number marking on all nouns, while 33 have optional number marking either on all nouns, on non-human nouns only (with obligatory number marking on human nouns) or on human nouns only (in which case the non-human ones are not marked for number). The remaining fourteen languages are characterized by the presence of nominal plural markers for human nouns, and the absence thereof for non-human nouns. (For the relation between animacy and plurality, see Chapter 7 in this volume.)

A second source of linguistic variation in the domain of number and quantity expressions is the quantity expression itself. Within a given language, several strategies can be found depending on the quantity expression that is used. In Mandarin, for instance, *hěn duō* 'a lot' is in many dialects optionally accompanied by a classifier while in all dialects it can be directly combined with nouns. For a quantity expression such as *dàliàng* 'a lot', on the other hand, classifier insertion is generally prohibited and numerals and expressions

such as *jii* ‘several’ always take a classifier (see also Doetjes, 2021). In some cases, the variation occurs within the class of numerals. The Mayan language Chol, for instance, has two types of numerals: traditional Mayan numerals, which require insertion of a classifier, and Spanish-based numerals, which are incompatible with numeral classifiers (Bale and Coon, 2014).

- (6)
- | | | | |
|----|-------------|--------------|--|
| a. | ux-p'ej | tyumuty | (Chol) |
| | three-CL | egg | |
| | | 'three eggs' | |
| b. | *ux | tyumuty | |
| | three | egg | |
| c. | *nuebe-p'ej | tyumuty | |
| | nine-CL | egg | |
| d. | nuebe | tyumuty | |
| | nine | egg | |
| | | 'nine eggs' | (Bale and Coon, 2014: 701, (13), (14)) |

p. 69 Similarly, numeral systems may impose singular, singulative, or plural number depending on the numeral (for cross-linguistic variation in the domain of numerals, see Ionin and Matushansky, 2018; Bylinina and Barbiers, 2019).

A final source of variation resides in nouns. As mentioned above, many languages make use of different strategies for human and non-human nouns. Besides that, smaller classes of exceptions may exist. For instance, English has a rather large class of nouns (*fish, sheep, salmon, aircraft*, etc.) that are compatible with numerals despite the fact that they do not have a distinct plural form: *one fish, two fish*.⁴ At first sight, these nouns resemble nouns such as *furniture*, which also lack plural forms despite their count semantics. However, unlike the noun *fish*, *furniture* grammatically behaves as a mass noun and cannot be combined with a numeral unless a measure word is inserted (**two furniture* vs *two pieces of furniture*; see also Chapter 3 in this volume). Another example of exceptional behaviour with respect to number marking is the lack of plural marking on some measure words and unit counters in Germanic languages, e.g. *head* in English (*two head of cattle*) and *jaar* ‘year’ in Dutch (*twee jaar* ‘lit. two year’; ‘two years’); see also note 3 above and references mentioned there. Contrary to nouns such as *fish*, these nouns have distinct plural forms (*heads* and *jaren* ‘years’), which are obligatorily used in other plural contexts (e.g. Dutch (*vele*) *jaren later* ‘(many) years later’). A final example is the Cushitic language Somali, where the presence of number in the context of a quantity expression interacts with gender (Saeed, 1999). Nouns that have a singular feminine form and a plural masculine form show up as a plural genitive in the context of a numeral, while for masculine nouns the singular genitive form is used (see Chapter 25 in this volume for shifts in gender that can be associated with number marking in Somali):

- (7)
- | | | | |
|----|--------|---------------|--|
| a. | sáddex | gabdhóod | (Somali) |
| | three | girl.M.PL.GEN | |
| | | 'three girls' | |
| b. | sáddex | wiil | |
| | three | boy.M.SG.GEN | |
| | | 'three boys' | (adapted from Saeed, 1999: 71, (44), (45)) |

p. 70 Considering the influence of nouns on the distribution of quantity expressions from a cross-linguistic point of view, one can also observe that languages differ in terms of which nouns can be used to denote pluralities. The Tupi language Yudja is an example of a language in which all nouns can be directly combined with

numerals. This is even true for so-called notional mass nouns (the counterparts of typical substance-denoting mass nouns in English, such as *water* and *blood*) suggesting that all nouns in this language have or at least can have a count meaning; see Lima (2014a) and Chapter 28 in this volume. Yudja is a language with optional number on human nouns only and as in the Dëne Sųliné examples in (4), numerals combine directly with unmarked nouns (Lima, 2014a). However, as mentioned above, notional mass nouns in Dëne Sųliné behave like ordinary mass nouns in the sense that they do not combine easily with numerals and other expressions that require count meaning (Wilhelm, 2008).

There are also factors that restrict possible variation. As mentioned, it is rare that a language combines numeral classifiers and plural marking on nouns. Moreover, there seems to be a difference between number markers on the one hand and numeral classifiers on the other with respect to their distribution with and without numerals. In general, languages with obligatory number marking on nouns in the context of numerals and other quantity expressions also have number marking on nouns in the absence of these quantity expressions. In Hungarian, for instance, number markers are obligatory in the context of definite determiners, while they cannot be inserted in the context of numerals and other quantity expressions. The mirror image of this pattern does not seem to occur. As far as I know, there are no languages in which number marking on nouns is optional or obligatory with quantity expressions while it is systematically absent in other grammatical structures. This type of requirement does not hold for numeral classifiers. In some numeral classifier languages, numeral classifiers are exclusively found in the context of numerals, e.g. the Austronesian language Minangkabau (Gil, 2005). Note that languages may have classifiers that are not used with numerals. These are different systems of nominal classification that are not related to individuation and counting (see also Chapter 10 in this volume).

4.3 The semantics of nouns and number marking

p. 71 Before turning to the semantic and distributional properties of quantity expressions in more detail, I will briefly go over the basic meaning types of nouns as these play a role in explaining the different patterns that are found. In general, it is assumed that nouns can be either kind denoting or predicate denoting (see Chapters 9 and 24 in this volume).⁵ The different types of count predicates that will be referred to below are summarized in (8), where singular individuals are represented as atoms and plural individuals as sums of atoms (see Chapter 2 in this volume).

(8)

a. singular count predicate:	set of atoms $\{a, b, c\}$
b. inclusive plural predicate:	atomic join semilattice $\{a, b, c, a \oplus b, a \oplus c, b \oplus c, a \oplus b \oplus c\}$
c. exclusive plural predicate:	atomic join semilattice minus the atoms $\{a \oplus b, a \oplus c, b \oplus c, a \oplus b \oplus c\}$
d. number-neutral count predicate:	atomic join semilattice $\{a, b, c, a \oplus b, a \oplus c, b \oplus c, a \oplus b \oplus c\}$

Inclusive plurality can be illustrated by the interpretation of the English plural under negation. The sentence in (9) is not true in case there is one book on the table, indicating that the negated predicate *books* includes both pluralities of books and atomic books (that is, it has the same extension as a number neutral count predicate).

(9)

There are no books on the table

For further discussion on inclusive and exclusive plurality, see Chapters 2, 7, 27, and 33 in this volume.

The case of mass predicates is more complex. As already indicated, the class of mass nouns in English is a morphological class, containing both substance-denoting nouns such as *water* and collective mass nouns such as *furniture*. The latter nouns have atomic reference and resemble count nouns in this regard. I will treat these nouns in their predicative use as number-neutral predicates (8d). Mass nouns such as *water* have been treated in (at least) two different ways. For Chierchia (1998a), who assumes that all nominal predicates correspond to atomic structures, mass nouns such as *water* constitute a special type of atomic predicate with vague atoms. In other words, the noun *water* is an atomic predicate, but it is not possible to pinpoint what the exact atoms are. This proposal offers an alternative to the theory of Link (1983), in which mass predicates correspond to non-atomic join semilattices (see also Chapter 3 in this volume). Following Chierchia, I will assume in this chapter that predicatively used mass nouns have the same type of denotation as number-neutral predicates, but that their atoms can be vague. In languages such as Dëne Sųłiné, where the count-mass distinction is not grammatically marked by means of number marking, mass predicates always have vague atoms. As a result of this, these nouns are incompatible with numerals and other cardinal quantity expressions, which need non-vague atoms. In a language with grammatical number marking such as English, the properties of mass nouns are less straightforward because of the interaction with number marking. Collective mass nouns such as *furniture* lack number marking despite the fact that their atoms are not vague. I will assume that these expressions are ‘mismatches’ in the sense that they have grammatical properties that do not correspond to their semantic properties (Chierchia, 2010, Cowper and Hall, 2012), but nothing hinges on this assumption.

There is no uniform one-to-one mapping between form and meaning of nominal predicates. For instance, a number-neutral predicate and an inclusive plural predicate have the same extensional semantics but differ in terms of whether plurality is morphologically marked or not.⁶ In addition, it has been argued that morphological plural marking on nouns in the context of quantity expressions can be attributed to plural agreement rather than to plural semantics of the predicate. This leaves open the possibility that the plural noun is singular rather than plural from a semantic point of view (I will come back to this). Another complicating factor is that both singular and number-neutral forms can be characterized by the absence of plural marking. The difficulty in establishing the meaning of an unmarked form can be illustrated by the Western Armenian data in (10) (Bale and Khanjian, 2014). Despite the fact that the same noun form is used in both examples, the definite noun phrase in (10a) is strictly singular, suggesting that the noun *dəgha* ‘child’ denotes a singular predicate (see (8a)), while the interpretation of (10a) suggests that the bare noun *dəgha* ‘child’ is a number-neutral predicate (see (8d)).

(10)

- | | |
|---|---|
| <p>a. <i>Dəgha-n</i> <i>vaze-ts.</i>
 boy(SG)-DEF run-PAST
 ‘The boy ran.’</p> <p>b. <i>Dəgha</i> <i>vaze-ts.</i>
 boy(SG) run-PAST
 ‘One or more boys ran.’</p> | <p>(Western Armenian)</p> <p>(Bale and Khanjian, 2014: 6, (11))</p> |
|---|---|

Not surprisingly, there are different analyses of the contrast illustrated in (10). On the one hand, Bale and Khanjian (2014) assume that the unmarked noun is number neutral in both (10a) and (10b), the singular reading of (10a) being derived by pragmatic blocking processes. On the other hand, Dayal (2011, 2015) argues for similar facts in Hungarian and in Hindi that the unmarked noun is semantically singular while an

apparent number-neutral reading of bare nouns in these languages is triggered by noun incorporation in combination with the presence of a pluractional operator on the verb.

p. 73 Given the complexity of the relation between the form and meaning of the nouns that are involved, it is not always straightforward what meaning nouns may or may not have in the context of quantity expressions and what factors are responsible for the existing patterns in the data.

4.4 Cardinal and non-cardinal quantity expressions

As illustrated in (1), numerals and quantity expressions such as *several* cannot be combined with a mass noun unless it is shifted to a count meaning: these expressions impose a discrete scale. Expressions such as *a lot*, on the other hand, can be combined with both count plurals and mass nouns.

Both types of quantity expressions are extremely common cross-linguistically. Even though not all languages have the highly abstract system of cardinal numerals that English does, all languages seem to have at least rudimentary numeral systems or at least vague cardinal expressions with a meaning similar to *a few* (Hurford, 2001).⁷ Cardinal quantity expressions can therefore be seen as a universal category in the inventory of quantity expressions in human languages and the same seems true for expressions such as *a lot* that express a quantity without imposing a discrete scale. As in the rest of the chapter, the following sections focus on adnominal quantity expressions (see also note 1 above).

This section compares these two basic types of quantity expressions, and examines how the empirical properties of these expressions are accounted for in the theoretical literature. The first two subsections address the semantic properties of the two types of quantity expressions. The third subsection evaluates the presented approaches in the light of cross-linguistic data.

4.4.1 Cardinal quantity expressions

In many languages, cardinal quantity expressions can be used with or without a determiner, as illustrated in (11a) and (11b) for the numeral *three*:

(11)

- a. The three books are on the table.
- b. Three books are on the table.

p. 74 In example (11a), the numeral *three* functions as a modifier (an expression of type $\langle\langle e, t \rangle, \langle e, t \rangle\rangle$) of the predicate *books* (type $\langle e, t \rangle$). The result of this modification, *three books*, is again a predicate, namely a set of plural individuals each made up of three books. In (11b), in the absence of the definite determiner, the phrase *three books* is generally assumed to be a generalized quantifier. A generalized quantifier is an expression of type $\langle\langle e, t \rangle, t \rangle$, which takes a predicate (type $\langle e, t \rangle$; in (11b) this is the predicate *are on the table*) and returns a truth value (type t). The numeral *three* provides the cardinality of the set that results from the intersection of books and things that are on the table.

According to some analyses, *three* in (11b) functions as a determiner, that is an expression of type $\langle\langle e, t \rangle, \langle\langle e, t \rangle, t \rangle\rangle$ that takes a predicate and turns it into a generalized quantifier. Others assume that *three* is a modifier both in (11a) and in (11b). Under this latter hypothesis, the generalized quantifier interpretation of *three books* in (11b) can be attributed to either a type shifting operation or to the presence of an empty determiner (see Hoeksema, 1983; Partee, 1986; Krifka, 1999; Ionin and Matushansky, 2006; Solt, 2015;

Rothstein, 2017 for discussion). In what follows, cardinal quantity expressions will be uniformly treated as modifiers.

This section reviews three types of approaches to numerals that differ from each other in terms of the assumptions that are made for the denotation of the complement of the numeral: a singular predicate, a plural or number-neutral predicate and a kind. All of the approaches that will be discussed below are originally formulated for numerals. However, they can be extended to other cardinal quantity expressions such as *several* or *many*, the main difference between these vague cardinal quantity expressions and numerals being the characterization of the cardinality indicated by the quantity expression (more than one in the case of *several* and above a contextual norm in the case of *many*).

4.4.1.1 Numerals combine with singular predicates

The first type of approach to numerals assumes that numerals combine with singular predicates. This theory has been worked out in detail by Ionin and Matushansky (2006, 2018), who argue that the noun *books* in *two hundred books* is in fact a singular from a semantic point of view, but realized morphologically as a plural form because of agreement. The morphological plural marking is therefore not reflecting the semantics of the noun, but rather the fact that the noun phrase as a whole has plural semantics. The singular requirement is a direct consequence of the compositional analysis of complex numerals the authors offer. In a noun phrase of the type *two hundred books*, the noun *books* denotes a set of atomic books, that is, a singular predicate, see (8a). A numeral *n* takes a set of entities as its argument and turns this set into a set of possible sums of *n* atomic elements. Thus, the meaning of *hundred books* is the set of all possible plural objects consisting of a sum of a hundred books. In order to derive *two hundred books*, the modifier *two* is added. This modifier takes as its complement the predicate *hundred books* and turns it into a set of sums of two non-overlapping sums of one hundred books, that is, a set of sums of two hundred books. The assumption that the complement of *two* in *two books* is a set of atoms makes it possible to assign the same semantics to *two* in *two books* and in *two hundred books*. In this approach, a numeral *n* is an expression that takes a set of entities, and forms on the basis of this set a new set of plural individuals each of which is composed of *n* non-overlapping entities from the original set.⁸

p. 75

The formal definition of the semantics of numerals is given in (12). As the result of applying a numeral *n* to a nominal predicate *P*, a set of plural individuals is created, each corresponding to a sum of *n* members of *P*. In order to count the number of atoms that are part of the plural individuals, the definition makes use of a partition Π . $\Pi(S)(x)$ divides a sum *x* (i.e. a plural individual) into non-overlapping parts, resulting in the set *S*.⁹ The numeral specifies the cardinality of the set *S* (in the example below, $|S| = 2$). Every member of *S* is a member of the singular predicate *P* denoted by the complement and corresponds to one unit of counting.

(12)

$$\llbracket \text{two} \rrbracket = \lambda P \in D_{\langle e, t \rangle} \lambda x \in D_e \exists S \in D_{\langle e, t \rangle} [\Pi(S)(x) \wedge |S| = 2 \wedge \forall s \in S P(s)]$$

(Ionin and Matushansky, 2006: 318, (5))

Even though Ionin and Matushansky do not make claims about this, the same type of definition could be used for expressions such as *several* or *many*, which rather than defining the cardinality in a precise way, offer a vague indication of the cardinality of the set *S*. For instance, for expressions such as *several* it should be specified that the cardinality of the set *S* is more than one ($|S| > 1$).

An important asset of the proposed semantics is that it can be applied recursively, so that complex numerals can be analysed compositionally, as illustrated in (13). The example in (13a) illustrates the application of the numeral *hundred* to the singular predicate *book*, resulting in a set of sums of a hundred books each. This resulting set can in turn be used as a complement for the numeral *two*, as illustrated in the example in (13b).

In this case, the units of counting are sums of a hundred books, provided by the predicate *hundred books* ((13b) is simplified by using $\llbracket \text{hundred books} \rrbracket$ instead of its denotation).

(13)

- a. $\llbracket \text{hundred books} \rrbracket = \lambda x \in D_e. \exists S [\Pi(S)(x) \wedge |S| = 100 \wedge \forall s \in S \llbracket \text{book} \rrbracket(s)]$
 b. $\llbracket \text{two hundred books} \rrbracket = \lambda x \in D_e. \exists S [\Pi(S)(x) \wedge |S| = 2 \wedge \forall s \in S \llbracket \text{hundred books} \rrbracket(s)]$
 (Ionin and Matushansky, 2006: 318–19, (8a), (9a))

p. 76 This approach only works if the complement of the numeral, the predicate P in (12), provides a set of units of counting, that is, a set of atoms in (12), a set of atomic books in (13a), and a set of sums of one hundred books in (13b). This is so, because every member of S should correspond to exactly one unit of counting. This implies that the approach introduces a singularity requirement on the nominal complement of a numeral and that the plural form *books* in *two hundred books* cannot be analysed as a semantic plural but must be singular from a semantic point of view. Ionin and Matushansky claim that the presence of the plural morphology is due to agreement. As the modified noun phrase as a whole is semantically plural, the head noun is morphologically marked by the plural morpheme. However, this agreement is not universal, as illustrated by languages such as Hungarian, Turkish, Finnish, and Welsh, where the plural form of the noun is not possible in the context of numerals:

(14)

három	gyerek/*három	gyerekek	(Hungarian)
three	child/ three	child.PL	
'three children'			(Farkas and de Swart, 2010: 10, (10a))

In this type of example, Ionin and Matushansky analyse the noun as both semantically and morphologically singular.

4.4.1.2 Numerals as restrictive modifiers

A second type of approach treats numerals as restrictive modifiers: the result of modification of a noun by a numeral is a subset of the set denoted by the noun. The analysis of numerals as restrictive modifiers goes back to Link (1983: 141) and was recently implemented by Bale et al. (2011a), who defend the hypothesis that restrictive modification is the only type of modification available for NP and VP. In other words, this hypothesis states that modification of a set denoted by an NP or a VP always results in a subset of this set. Their hypothesis, which they call the 'Strong Thesis', goes back to Partee's (2010) claim that all adjectival modification is restrictive modification. Under the Strong Thesis, the type of approach offered by Ionin and Matushansky, in which the numeral turns a set of atoms into a set of plural individuals, is excluded, as the result of the modification (set of plural individuals) is not a subset of the original set denoted by the NP (a set of atoms). Bale et al. do not address the compositionality of complex numerals, but see Rothstein (2017), who offers an analysis of adnominal numerals as restrictive modifiers while also accounting for the compositionality of complex numerals.

Bale et al. define an alternative to Ionin and Matushansky's analysis in (12), which is given in (15). The predicate P_{pl} to which the numeral applies is either number neutral or an inclusive plural predicate (i.e. a predicate that contains both atoms and plural individuals) and $\text{MIN}(P_{pl})$ is defined as the set of atoms of P_{pl} . The atoms thus still introduce the units of counting and the main difference between (12) and (15) is that the complement of the numeral in (12) directly provides the atoms, while the atoms need to be extracted from an inclusive plural or number-neutral predicate in $\hookrightarrow$ case of (15). In order to facilitate the comparison between the two analyses, the notation of Ionin and Matushansky (2006) is used and the differences are signalled in bold.

p. 77

(15)

$$\llbracket \text{two} \rrbracket = \lambda P_{\text{pl}} \in D_{\langle e, t \rangle} \cdot \lambda x \in P_{\text{pl}} \cdot \exists S [\Pi(S)(x) \wedge |S| = 2 \wedge \forall s \in S [S \in \text{MIN}(P_{\text{pl}})]]$$

(adapted from Bale et al., 2011a: 591, (20))

The definition in (15) cannot be applied to exclusive plurals, as these only contain plural individuals (see (8c)). Therefore, they do not permit the extraction of a set of atoms which could be used to define possible counting units. Bale et al. (2011a) argue that some languages permit the use of numerals with exclusive plurals, while other languages do not allow for this. In the first type of languages, the units of counting are defined independently of the complement of the numeral as in (16), where the units of counting (the members of the set S) are atoms in the domain of the model.

(16)

$$\llbracket \text{two} \rrbracket = \lambda P \in D_{\langle e, t \rangle} \cdot \lambda x \in P \cdot \exists S [\Pi(S)(x) \wedge |S| = n \wedge \forall s \in S \text{ATOM}(s)]$$

(adapted from Bale et al., 2011a: 593, (25a))

The two definitions for numerals in (15) and (16) allow Bale et al. to account for cross-linguistic variation. Whereas in Western Armenian plural marking with numerals is optional (see the examples in (5)), plural marking is impossible in the context of numerals in Turkish and Hungarian (see (14)). Bale et al. (2011a) claim that in this latter type of language numerals have the semantics given in (15).¹⁰ Under the assumption that the plural noun in Hungarian and Turkish corresponds to an exclusive plural predicate, this predicts that only a number-neutral noun can be used, while the (exclusive) plural is prohibited. For Western Armenian, on the other hand, they claim that numerals have the more permissive definition given in (16), which allows for the use of both a number-neutral and an exclusive plural noun, hence it accounts for the choice between the two forms illustrated in (5).

4.4.1.3 Numerals combine with kind-denoting nouns

A third type of approach to numerals treats them as non-restrictive modifiers that turn a kind-denoting noun into a set of plural individuals. The numeral both transforms the noun into a set of sums and specifies the number of atoms corresponding to each sum (Krifka, 1995a). The derivation of the noun phrase *three bears* is given in (17) (Krifka, 1995a: 406). The denotation of the noun *bear* is the bear kind ('Ursus'), R_i is the realization relation that relates kinds to their specimens in situation i , and OU_i (for 'object unit') is an operator that takes a kind, and yields a measure function that measures the number of specimens of that kind in a possible world i .¹¹

(17)

- a. $\llbracket \text{bear} \rrbracket = \text{Ursus}$
 - b. $\llbracket \text{three} \rrbracket = \lambda y \lambda i \lambda x [R_i(x, y) \ \& \ \text{OU}_i(y)(x) = 3]$
 - c. $\llbracket \text{three} \rrbracket (\llbracket \text{bear} \rrbracket) = \lambda i \lambda x [R_i(x, \text{Ursus}) \ \& \ \text{OU}_i(\text{Ursus})(x) = 3]$
- (adapted from Krifka, 1995a: 406, (12))

Combining the numeral *three* in (17b) with the noun *bear* in (17a) results in (17c): in a possible world i , *three bears* denotes a set of sums of three specimens of the kind 'Ursus'.

In Mandarin, on the other hand, the numeral only expresses cardinality and does not incorporate a measure function as illustrated in (18). As a result, it is not possible to combine the numeral directly with another expression, unless this other expression selects a cardinal numeral. Numeral classifiers, such as *zhī*, the classifier for the noun *xíong* 'bear', in (18c) are defined as expressions that select a numeral and form a more

complex numeral that has the same semantics as numerals in a language like English, the meaning of *sān zhī* in (18d) being the same as the meaning of *three* in (17b).

(18)

- a. $\llbracket xióng \rrbracket = \text{Ursus}$
 - b. $\llbracket sān \rrbracket = 3$
 - c. $\llbracket zhī \rrbracket = \lambda n \lambda y \lambda i \lambda x [R_i(x, y) \ \& \ OU_i(y)(x) = n]$
 - d. $\llbracket sān \ zhī \rrbracket = \llbracket zhī \rrbracket (\llbracket sān \rrbracket) = \lambda y \lambda i \lambda x [R_i(x, y) \ \& \ OU_i(y)(x) = 3]$
 - e. $\llbracket sān \ zhī \rrbracket (\llbracket xióng \rrbracket) = \lambda i \lambda x [R_i(x, \text{Ursus}) \ \& \ OU_i(\text{Ursus})(x) = 3]$
- (adapted from Krifka, 1995a: 401, (5))

Krifka thus proposes a different semantics for numerals in classifier languages and in non-classifier languages: numerals in non-classifier languages can be considered as containing built-in classifiers. In both types of languages, the noun is assumed to denote a kind. A variant of this analysis has been proposed by Bale and Coon (2014), who assume that the noun is a predicate. This shows that the two parts of the proposal (i.e. the assumption that numerals may incorporate a measure function and the claim that nouns that combine with numerals denote kinds) are independent of one another.

According to Krifka, the singular and the plural noun forms used in the context of numerals have the same semantic representation: the form of the noun is triggered by the syntactic context and does not influence the semantics. As in the case of Ionin and Matushansky (2006), Krifka takes the patterns in languages such as Hungarian as illustrated in (14) as evidence for this claim. Another argument put forward by Krifka is the fact that plural marking may be obligatory in the absence of semantic plurality, as in $\hookrightarrow$ *zero bears* and *1.0 bears*. This is why, contrary to Ionin and Matushansky, he does not ascribe the presence of the plural noun (e.g. *bears* in *three bears*) to semantic agreement triggered by the plural meaning of the noun phrase as a whole, but to a purely syntactic requirement triggered by the selection requirements of the quantity expression.

Krifka (1995a) also offers an alternative analysis, which accounts for the distinction between English and Mandarin without assuming that numerals in the two types of languages are distinct and which proposes yet a different type of noun meaning. In this view, the numeral *three* has the same interpretation as Mandarin *sān* ($\llbracket three \rrbracket = \llbracket sān \rrbracket = 3$), and therefore cannot directly combine with a noun. In order to combine the numeral with mass nouns, a measure word is inserted. This measure word has the same semantic function as the classifier in Mandarin (see (18c)). Count nouns in a language like English do not need the insertion of a measure word or classifier, because they have a special type of denotation; in this alternative approach, it is the noun that has a ‘built-in’ classifier. As a result, the noun functions as a relational noun that takes a number argument, as defined in (19):

(19)

$$\llbracket bear(s) \rrbracket = \lambda n \lambda i \lambda x [RT_i(x, \text{Ursus}) \ \& \ OU_i(\text{Ursus})(x) = n]$$

(adapted from Krifka, 1995a: 407, (13))

This type of approach is not limited to cardinal quantity expressions, as recently shown by Rett (2018). I will come back to this in the next section.

4.4.2 Non-cardinal quantity expressions

The second large class of quantity expressions is not restricted to count nouns and does not imply plurality. Examples in English are *a lot* and *more*. In English, these quantity expressions typically combine both with mass nouns and with count plurals, as illustrated for *a lot* (20a). A subclass of these expressions is limited to mass nouns, as illustrated for *a bit* in (20b).

(20)

- a. a lot of water/pens/#pen
- b. a bit of water/*pens

As in the case of the cardinal quantity expressions discussed in the previous section, I will treat these quantity expressions as modifiers of nominal predicates (expressions of type $\langle\langle e, t \rangle, \langle e, t \rangle\rangle$) rather than as determiners (expressions of type $\langle\langle e, t \rangle, \langle\langle e, t \rangle, t \rangle\rangle$; for discussion and references, see section 4.4.1). As in the preceding section, I will focus on number-related properties of the nouns these expressions modify, as illustrated by the use of mass nouns and plurals in (20).

Both mass nouns and plurals are characterized by cumulative reference, as illustrated by the validity of the following inferences (Quine, 1960, Link, 1983):

p. 80

(21)

- a. If *a* is water and *b* is water, then the sum of *a* and *b* is water.
- b. If the animals in this camp are horses, and the animals in that camp are horses, then the animals in both camps are horses. (Link, 1983: 128, (10))

This is one of the reasons for Link to represent both plurals and mass nouns as join semilattices, for which cumulative reference obtains (see also Chapter 2 in this volume). Singular predicates denote sets of atoms, and do not share this property: if *A* is an apple and *B* is an apple, we cannot conclude that *A* and *B* together are an apple. Given that cumulative reference is a property mass nouns and plurals share, it has been claimed that quantity expressions such as *more* and *a lot* are sensitive to cumulative reference (see for instance Doetjes, 1997; Deal, 2017).

The main difference between cardinal quantity expressions such as numerals and expressions such as *a lot* is that the latter do not only define cardinal quantities, as they also permit an evaluation of the quantities they define in terms of for instance weight or volume. In general this is formalized by means of a measure function that is not specified for a specific type of scale (cf. Chierchia, 1998a; Schwarzschild, 2002; Wellwood et al., 2012, Solt, 2015; Rett, 2018). An implementation in which the quantity expression *a lot* is treated as a restrictive modifier is given in (22). The context-dependent measure function μ_C takes a sum *x* and measures the quantity of this sum, resulting in a degree on a context-dependent scale; the choice of the scale (cardinality, weight, volume) depends on the context in which *a lot* is used. Whereas the size of the sums is normally based on the number of P-atoms as in *a lot of pens*, it can also correspond to a scale of volume or weight, resulting in compatibility with mass predicates (*a lot of water*).¹²

(22)

$$\llbracket a \text{ lot} \rrbracket = \lambda P \lambda x. [P(x) \wedge \mu_C(x) \geq d_C]$$

where d_C is a contextually given standard of comparison

The degree resulting from measuring a sum x in (22) needs to be larger than a contextually given standard d_C , which defines the minimal size of a large quantity in a particular context (cf. Kennedy and McNally's (2005) notion of relative standard). In a context where the relative standard for quantities of water corresponds to 2 litres, $\llbracket a \text{ lot of water} \rrbracket$ would denote the set of sums of water that have a volume that is larger than two litres.

p. 81

Given the semantics of (22), it is not immediately clear why quantity expressions such as *a lot* and *more* typically combine with predicates that have cumulative reference. According to Chierchia (1998a), the use of these quantity expressions with plural rather than singular count nouns is due to the fact that when these quantity expressions are combined with a count noun, the most salient measure function is the one that results in a cardinality reading, that is a reading in which the size of x is measured in terms of its cardinality. This only makes sense if the cardinality of x varies. For a singular predicate, the cardinality of every member of the predicate is 1, while for $\downarrow$ a number-neutral or plural predicate, the cardinality varies resulting in cumulative reference. The salience of this measure function is in accordance with a preference for cardinality readings in quantity judgement tasks with the quantity expression *more* (Barner and Snedeker, 2005; see also Chapter 3 in this volume). As the quantity judgement studies of Barner and Snedeker show, *more N* is preferably interpreted as a cardinality (a larger number of items) whenever the noun has an interpretation for which it is clear what the countable atoms are, as in *more pens* or *more furniture*. Only for nouns such as *toothpaste*, for which it is not clear what counts as a default unit, an interpretation in terms of volume is preferred, *more toothpaste* being interpreted as a larger total volume of toothpaste (see also Chapter 3 in this volume).

Chierchia's idea that the restriction on cumulative reference is a side effect of the preference for a cardinality reading might shed light on a particular use of expressions such as *a lot* and *more* illustrated by the slogan in (23), where *more* modifies the singular noun *house*. *More* indicates in this example the amount of space a house defines and not a number of houses (see for instance Beviláqua and Pires de Oliveira, 2014, for recent discussion on this type of reading).

(23)

Buy more house for less money!

On the one hand, this example could be analysed in terms of a shift from a count meaning (a set of atomic houses) to a mass meaning (house space), in which case *house* would be a mass predicate, and as such have cumulative reference.¹³ However, one could also assume that the noun *house* modified by *more* (23) is a singular predicate with a count meaning. The particular context in which this type of example is possible makes a salient measure function available that measures atomic entities in terms of their volume or weight. If this is on the right track, cases such as (23) constitute examples of the limited possibilities to combine non-cardinal quantity expressions with semantically singular, non-cumulative, predicates.

As illustrated above, some quantity expressions such as *much*, *a little*, and *a bit* can only be combined with mass nouns and do not permit the use of plural nouns. These are in many cases expressions that define a small global quantity (see Chapter 27 in this volume). This type of condition can be formalized in different ways. On the one hand, it could be the case that these quantity expressions were inherently incompatible with either plural nouns or nouns that have a count interpretation. Alternatively, the restriction on *much*, *a little*, and *a bit* could be due to competition with the cardinal quantity expressions *many* and *a few* (see Doetjes, 2021, for arguments in favour of this latter approach).¹⁴ In this chapter I will not further discuss the nature of the restriction on expressions such as *much*, *a little*, and *a bit*.

p. 82 In the above discussion, the nouns that are modified by the non-cardinal quantity expressions are assumed to be predicates. There also exist analyses that do not make this assumption.

On the one hand, Rett (2018) argues that nouns may include a variable over degrees (see Cresswell, 1976). Expressions such as *much* and *many* are analysed as predicates of degrees and modify the degree variable introduced by the noun. Rett's analysis makes nouns more similar to scalar adjectives, which is in line with the observation that a subset of non-cardinal quantity expressions can be used to modify scalar adjectives (e.g. *more* in *more beautiful*). The approach is related to Krifka's (1995a) proposal for count nouns in English, in which a 'built-in classifier' introduces a variable over cardinalities (see (19)). However, whereas Krifka makes this assumption for count nouns only (thus explaining why they are compatible with numerals), the proposal of Rett applies to all nouns. As a result of this, the cross-linguistic predictions of the two approaches are quite different.

On the other hand, some authors claim that non-cardinal quantity expressions combine with kinds, at least in some languages (see in particular Pires de Oliveira and Rothstein, 2011, for Brazilian Portuguese). This implies an analysis in which these quantity expressions incorporate an operator that turns a kind-denoting expression into a predicate, along the lines of the analysis of the numerals in (17) (Krifka, 1995a). In the remainder of this chapter I will not consider these two types of approaches, and assume that the nouns that are modified by non-cardinal quantity expressions are predicates.

4.4.3 Cross-linguistic variation

The beginning of this chapter introduced three strategies that are found across languages for combining quantity expressions and nouns. Each of these strategies can occur in the context of cardinal quantity expressions as well as in the context of non-cardinal quantity expressions, but as one may expect given the semantic differences between the two types of expressions, these expressions do not necessarily behave in the same way in a single language. In general, number marking and/or classifiers are more often optionally or obligatorily present in the context of numerals and other cardinal quantity expressions than in the context of non-cardinal quantity expressions such as *a lot*. In what follows, I will discuss the two types of quantity expressions introduced in the previous subsections in relation to cross-linguistic variation. Section 4.4.3.1 focuses on the distribution of number marking in the context of the two types of quantity expressions. Section 4.4.3.2 addresses the types of strategies used with cardinal and non-cardinal quantity expressions in numeral classifier languages.

p. 83 4.4.3.1 Presence and absence of number marking

As discussed in section 4.4.1, both Ionin and Matushansky (2006) and Bale et al. (2011a) make strong claims about universal properties of cardinal numerals, which are mutually exclusive. While Ionin and Matushansky claim that cardinal numerals universally combine with semantically singular nouns, Bale et al. postulate that nominal modification is always restrictive, which implies that semantically singular nouns are expected to only be possible in the context of numerals that correspond to 'one'. In view of cross-linguistic data, both claims may well be too strong.

An important difference between the two types of approaches constitutes the way non-plural nouns are treated in examples such as (14), repeated here in (24):

(24)

három	gyerek/*három	gyerekek	(Hungarian)
three	child/	three child.PL	
'three children'			(Farkas and de Swart, 2010: 10, (10a))

If numerals universally combine with singular predicates, the noun *gyerek* 'child' should be analysed as a singular predicate, while it needs to be number neutral if numerals are analysed as restrictive modifiers.

Turning now to non-cardinal quantity expressions such as *a lot*, the two types of analyses of bare non-plural marked nouns in the context of numerals make different predictions. Recall that non-cardinal quantity expressions typically combine with expressions that have cumulative reference. Semantically singular count nouns give rise to a very particular interpretation and crucially cannot get a number reading (e.g. ‘a large number of N’ in the case of *a lot*). If the non-plural noun modified by the numeral in (24) is semantically singular, as proposed by Ionin and Matushansky, one expects a plural noun to be used with non-cardinal quantity expressions, unless a special reading is obtained, exactly as in English (cf. *#more child* vs *more children*). On the other hand, if the noun is number neutral, as argued by Bale et al., it is predicted to also combine with non-cardinal quantity expressions, resulting in the same type of reading as a plural noun in English. As it turns out, both types of patterns exist.

In Hungarian, degree-based quantity expressions combine with unmarked count nouns and with mass nouns as illustrated in (25). The use of a plural noun is excluded, as in the case of numerals.

(25)

- a. sok gyerek/*gyerekek (Hungarian)
 a-lot child/ child.PL
 ‘a lot of children’ (adapted from Farkas and de Swart, 2010: 6:10, (10b))
- b. sok víz
 a-lot water
 ‘a lot of water’ (Anikó Lipták, p.c.)

p. 84 Taking (25) to be an argument that *sok* is not a cardinal quantity expression, and that it combines with nominal predicates that have cumulative reference independently of their mass or count status, these data constitute evidence in favour of number neutrality of the noun *gyerek* ‘child’.¹⁵ If *gyerek* were semantically singular, one would expect to find *gyerekek* in the context of *sok* and we would expect the use of *gyerek* to lead to the type of reading illustrated for English in (23), contrary to fact: *sok gyerek* in (25a) is interpreted as ‘a large number of children’ (i.e. the cardinality reading).

The pattern found in Hungarian is also found in Turkish (*çok çocuk(*lar)* lit. ‘a lot of child(*ren)’; *çok su* ‘a lot of water’; Güliz Güneş, p.c.). In Western Armenian, the modifier *lad* ‘a lot’ combines normally with non-plural nouns, even though the plural is not always excluded (Sigler, 1997: 147–8; recall that the plural is also possible with numerals, see (5)).¹⁶ The patterns found in these languages offer independent evidence for a number-neutral interpretation of the non-plural noun, as predicted under the hypothesis of Bale et al. (2011a). In order to maintain their hypothesis, Ionin and Matushansky would need to assume that the non-plural marked noun could have both a singular and a number-neutral meaning. This is also what they would have to stipulate for languages that lack a morphological singular–plural opposition on nouns, such as Dëne Słliné (Wilhelm, 2008).

Whereas Hungarian, Turkish, and Western Armenian offer evidence in favour of treating non-plural nouns as number neutral, Tunisian Arabic constitutes an example of a language in which numerals above ten combine with singulative nouns, which are formed by adding singulative morphology to a collective noun.¹⁷ This is illustrated by the example in (26), taken from Chapter 13 in this volume. In this example, the numeral *sbaʕtaʃ* ‘seventeen’ modifies a singulative noun (in the context of numerals, the singulative noun is preceded by [n], the status of which is not clear):¹⁸

(26)

- klit sbaʕtaʃ nħut-a (Tunisian Arabic)
 ate.1SG seventeen fish-F.SINGULATIVE
 ‘I ate seventeen fish.’ (Chapter 13 in this volume, p. 289 (25a))

p. 85 The fact that the noun is a singulative makes it quite likely that we are dealing with a semantically singular noun in this case.¹⁹ This is confirmed by the distribution of nouns in the context of non-cardinal quantity expressions such as *barcha* ‘a lot’, which combine with collective nouns and with mass nouns, but not with singulatives:

(27)

- | | | | | |
|----|---------|--------|--|---------------------|
| a. | klit | barcha | hut. | (Tunisian Arabic) |
| | ate.1SG | a.lot | fish-COLLECTIVE | |
| | | | ‘I ate a lot of fish/many fish.’ | |
| b. | klit | barcha | ʕsida. | |
| | ate.1SG | a.lot | porridge | |
| | | | ‘I ate a lot of porridge.’ | |
| c. | *klit | barcha | (n)hut-a. | |
| | ate.1SG | a.lot | fish-F.SINGULATIVE | |
| | | | intended: ‘I ate a lot of fish/many fish.’ | (Myriam Dali, p.c.) |

In case a noun does not have a collective form, as in *kalb* ‘dog.SG’/*kleb* ‘dog.PL’, the plural is used (see **barcha kalb* ‘a lot of dog’ vs *barcha kleb* ‘a lot of dogs’; Myriam Dali, p.c.).

Similarly, in Finnish, cardinal quantity expressions such as the numerals and *monta* ‘many’ combine with singular partitive nouns (except for the numeral *yksi* ‘one’ which takes a non-partitive singular), while non-cardinal quantity expressions such as *vähän* ‘few, (a) little’ and *paljon* ‘a lot’ combine with singular partitive mass nouns and plural partitive count nouns:

(28)

- | | | | | | |
|----|----------------|-----------|-------------------|-------------------------|-----------|
| a. | monta | nais-ta; | kaksi | tyttö-ä | (Finnish) |
| | many | woman-PRT | two | girl-PRT | |
| | | | | ‘many women; two girls’ | |
| b. | vähän | | maito-a | | |
| | small.quantity | | milk-PRT | | |
| | | | ‘(a) little milk’ | | |
| c. | vähän | | auto-j-a | | |
| | small.quantity | | car-PL-PRT | | |
| | | | ‘few cars’ | | |
- (adapted from Karlsson, 1999: 89)

p. 86 These data illustrate the pattern that one would expect if numerals and other cardinal quantity expressions take semantically singular nouns, whereas non-cardinal quantity ↓ expressions combine with expressions that have cumulative reference. Note also that the distribution of Finnish *monta* ‘many’ shows that cardinal numerals and vague cardinal quantity expressions pattern alike and both take singular nouns as their complements.

To conclude, there seem to be two types of languages in which numerals are directly combined with nouns that are not marked for plurality. On the one hand, there are languages such as Hungarian, Turkish, and Western Armenian, in which non-cardinal quantity expressions also combine with count nouns that lack plural marking, suggesting that these non-plural nouns have a number-neutral interpretation. On the other hand, there are languages such as Tunisian Arabic and Finnish, in which the pattern found for cardinal and for non-cardinal quantity expressions is different. Finnish cardinal quantity expressions take non-plural count nouns, while non-cardinal quantity expressions take plurals and mass nouns. Given the existence of these two patterns, it may very well be the case that both the points of view of Ionin and Matushansky (2006) and that of Bale et al. (2011a) are too strong. On the one hand, Hungarian, Turkish, and Western Armenian exhibit the pattern one would expect if both cardinal and non-cardinal quantity expressions involve

restrictive modification. These languages offer evidence that numerals may modify number-neutral nouns. On the other hand, the patterns in Tunisian Arabic and Finnish suggest that cardinal quantity expressions can combine with nouns that are semantically singular, which is in contradiction with the hypothesis that numerals always function as restrictive modifiers.

4.4.3.2 Presence and absence of numeral classifiers

Languages with obligatory use of numeral classifiers in the context of numerals and other cardinal quantity expressions often use different strategies in the context of cardinal and non-cardinal quantity expressions.

In Mandarin, cardinal quantity expressions such as the numerals and for instance *jǐ* ‘how many, a few’ obligatorily take classifiers. In case the noun can have a count interpretation, a sortal classifier can be used, while non-sortal classifiers add a unit of counting which is not present in the meaning of the noun; this latter class includes measure words (see Chapter 10 in this volume). Non-cardinal quantity expressions are normally incompatible with classifiers (e.g. *dàliàng* ‘a lot’, *suǒyǒu* ‘all’, *quánbù* ‘all’, *dàbùfēn* ‘most’) as illustrated in (29):²⁰

(29)

- a. *dàliàng de (*duǒ) huā* (Mandarin)
a.lot DE (*CL) flower
‘a lot of flowers’
- b. *dàliàng de (*píng) shuǐ*
a.lot DE (*CL^{bottle}) water
‘a lot of water’ (adapted from Zhang, 2013: 85, (154))

p. 87 The non-cardinal quantity expression *hěn duō* ‘a lot’ shows a slightly different behaviour, as it is for many speakers compatible with a classifier, even though some speakers reject the use of classifiers (Doetjes, 2012). For the former speakers, *hěn duō* ‘a lot’ resembles its Cantonese counterpart *hou² do¹* ‘a lot’, which permits the use of a classifier for all speakers (Cheng et al., 2012).²¹

(30)

- a. *hěn duō (%bēn) shū dōu zài tā-de zhuōzi shàng.* (Mandarin)
a.lot CL book DOU at he-DE table top
‘A lot of books are on his table.’
- b. *hou² do¹ (bun²) syu¹ dou¹ hai² keoi⁵-ge³ toi² seong⁶min⁶.* (Cantonese)
a.lot CL book DOU at he-GE table top
‘A lot of books are on his table.’ (adapted from Cheng et al., 2012: 178, (9))

The data follow what seems to be a general pattern in numeral classifier languages: cardinal quantity expressions require insertion of a classifier, while classifiers are either optional or impossible in the context of non-cardinal quantity expressions such as Mandarin *dàliàng* ‘a lot’ and *hěn duō* ‘a lot’. An interesting exception is Mandarin *dàduōshù* ‘many’, lit. ‘large number’, which is for some speakers restricted to nouns with a count interpretation, despite the fact that it is incompatible with classifiers (Zhang, 2013: 139, see Doetjes, 2021). The varied judgements suggest that this quantity expression is in the process of losing its restriction to count environments, which could be triggered by the general system of Mandarin, where cardinal quantity expressions take classifiers by default.

In languages with optional numeral classifiers, the use of classifiers also seems more restricted with non-cardinal quantity expressions. In Hungarian, for instance, classifiers cannot be used with non-cardinal

quantity expressions such as *sok* ‘a lot’ (Anikó Lipták, p.c.), while they can be optionally inserted in the context of numerals (Schvarcz and Rothstein, 2017):

(31)

a. három (darab) könyv

three CL^{general} book

‘three books’

(Hungarian)

b. sok (*darab) könyv

a.lot CL^{general} book

‘a lot of books’

(Anikó Lipták, p.c.)

(Schvarcz and Rothstein, 2017: 186, (7a))

p. 88 In general, it seems to be the case that numeral classifiers are much less common in the context of non-cardinal quantity expressions. I am not aware of languages with quantity expressions that require insertion of a sortal classifier with nouns that have a count meaning, but at the same time allow mass nouns without a classifier. On the other hand, examples of non-cardinal quantity expressions that do not allow for classifier insertion in an obligatory classifier language do exist, as illustrated by Mandarin *dàliàng* ‘a lot’ in (29).

4.4.3.3 Cross-linguistic variation and optionality

As indicated at the beginning of this chapter, languages make use of different strategies to create nominal constituents containing quantity expressions and nouns. Some languages require plural marking or singular marking, others make use of numeral classifiers, and yet others permit quantity expressions to combine with nouns that are not marked for number. As illustrated in the preceding sections, the type of strategy can vary depending on the quantity expression within a single language. Even though numeral classifiers can be found with cardinal and with non-cardinal quantity expressions, they are more commonly found in the context of cardinal quantity expressions. In the context of non-cardinal quantity expressions classifiers are either optional or prohibited.

A large amount of variation is due to optionality. Optional plural marking and optional classifier insertion can be accounted for in different ways, depending on the type of analysis that is given for, e.g. numerals. For instance, Bale et al. (2011a), argue that languages with number-neutral predicates allow for optional plural marking in case the numeral is blind to the difference between number-neutral predicates and exclusive plurality. For languages in which some nouns take plural marking in the context of a quantity expression (e.g. human nouns) while others do not, the requirement of plural marking is likely to be due to properties of the noun rather than to properties of the quantity expression.

As for classifiers, Bale and Coon (2014) ascribe the optionality of classifiers in Western Armenian to ambiguity of the numeral: one of the two homophonous forms of the numeral requires the classifier to be present, while the other can directly combine with a plural or a number-neutral noun. Other authors assume that optionality of classifiers is due to the presence of a silent classifier (Dalrymple and Mofu, 2012).

The different approaches to optionality illustrate the difficulty of establishing the source of the optionality, as well as the importance of having a complete picture of a language so that the properties of different types of nouns and quantity expressions can be taken into account.

4.5 Distributivity, number, and a typology of universal quantifiers

A particular class of quantity expressions is formed by universal quantifiers. Even though in some languages the words for ‘all’ and ‘a lot’ have similar distributions (e.g. Mandarin, where the pattern illustrated in (29) for *dàliàng* ‘a lot’ also holds for *suǒyǒu* ‘all’ and *quánbù* ‘all’), universal quantifiers may also behave quite differently from other quantity expressions. For instance, English *all* may precede the definite article as in *all the books*.

Universal quantifiers are commonly subdivided into two main types, depending on whether they impose a distributive reading or not.²² Whereas *every* is always interpreted as a distributive quantifier, *all* may have both a distributive and a collective reading. As a result of this, only *all* can be used in the subject of a collective predicate, while both can be used with distributive predicates:

(32)

- a. *Every man gathered at dawn.
 - b. All men gathered at dawn.
 - c. Every man carried three suitcases.
 - d. All men carried three suitcases.
- (Gil, 1995: 322, (1), (2))

As the examples show, the difference in distributivity correlates with a difference in the number that is selected on the noun. Even though Gil claims that distributive quantifiers are always universal (his *Universal 1* (1995: 326)), non-universal quantity expressions may also be distributive, as illustrated for Dutch *menig* ‘several, many’ as opposed to *veel* ‘a lot’ in (33). While *menig* only accepts a distributive predicate (33a) vs (33c), *veel* is compatible with collective and distributive predicates (33b, d). As in the case of *every*, the distributivity of *menig* correlates with the use of singular morphology on the noun and, in case of a subject, singular agreement with the verb.

(33)

- a. *Menig student kwam samen in de grote hal. (Dutch)
many.DIST student.SG come.PAST.SG together in the big hall
‘Many students gathered in the big hall.’
- b. Veel studenten kwamen samen in de grote hal.
a.lot student-PL come.PAST-PL together in the big hall
‘A lot of students gathered in the big hall.’
- c. Menig student droeg drie koffers.
many.DIST student.SG carry.PAST.SG three suitcases
‘Many students carried three suitcases.’
- d. Veel studenten droegen drie koffers.
many student-PL carry.PAST-PL three suitcases
‘Many students carried three suitcases.’

The relation between number and distributivity is captured by Gil in his second universal (the term non-distributive quantifier refers to quantifiers such as *all* that are compatible with both distributive and collective predicates and as such do not impose distributivity):

(34)

Universal 2 [Number Morphology]

If a distributive-key universal quantifier and its simple counterpart are associated, in a certain construction, with different number morphology, then the distributive-key universal quantifier is associated with singular morphology and the non-distributive universal quantifier with plural morphology. (Gil, 1995: 328, (14))

Given the data in (33), this universal should be understood as a condition on distributive quantifiers in general rather than a condition on universal quantifiers (cf. Chierchia, 1998a). It is true, however, that distributivity is commonly found for universal quantifiers while it seems to be rather rare for non-universal quantity expressions.

The universal in (34) only takes into account count nouns. Another difference between *all* and *every* is that the former is compatible with mass nouns while the latter is not, unless the meaning of the mass noun shifts to a count interpretation.²³

(35)

- a. all (the) student*(-s)/all (the) water
- b. every student(*-s)/#every water

The pattern illustrated in (35) also seems to illustrate a universal property:

(36)

Whereas non-distributive universal quantifiers are insensitive to the count-mass distinction, distributive universal quantifiers can only be interpreted with respect to nouns that have a count interpretation.

p. 91 Let us first turn to Mandarin. In Mandarin, the distributive universal quantifier *měi* ‘every’ is in complementary distribution with the demonstrative and requires the insertion of a classifier which may be accompanied by *yī* ‘one, a’ (Tang, 2007; Cheng, 2009).

(37)

- | | | | | |
|----|-------------------------|---------------------------------------|-----------------|------------|
| a. | <i>měi</i> | (<i>yī</i>)- <i>ge</i> | <i>xuéshēng</i> | (Mandarin) |
| | every | (one)-CL ^{general} | student | |
| | ‘every student’ | | | |
| b. | <i>měi</i> | (<i>yī</i>) <i>píng</i> <i>shuǐ</i> | | |
| | every | (one) CL ^{bottle} | water | |
| | ‘every bottle of water’ | | | |

On the other hand, the non-distributive universal quantifiers *suǒyǒu* ‘all’ and *quánbù* ‘all’ are incompatible with classifiers, and have a distribution that is similar to *dàliàng* ‘a lot’ in (29) (*de* is optional for some speakers—see also note 20):

(38)

- | | | | | | |
|----|----------------------|-----------|---------------------------------|-----------------|------------|
| a. | <i>suǒyǒu/quánbù</i> | <i>de</i> | (<i>*duō</i>) | <i>xuéshēng</i> | (Mandarin) |
| | all | DE | (<i>*CL</i>) | student | |
| | ‘all students’ | | | | |
| b. | <i>suǒyǒu/quánbù</i> | <i>de</i> | (<i>*píng</i>) | <i>shuǐ</i> | |
| | all | DE | (<i>*CL^{bottle}</i>) | water | |
| | ‘all water’ | | | | |

In other words, non-distributive universal quantifiers are insensitive to the count–mass distinction, while distributive *měi* ‘every’ is similar to cardinal quantity expressions in triggering insertion of a numeral classifier.

Yet another typologically different language in which a similar pattern holds is Cuzco Quechua (Quechuan, Faller and Hastings, 2008). In this language, plural marking is optional. As shown in the examples in (39), the distributive universal quantifier *sapanka* combines both with typical count nouns such as *runa* ‘person’ but also with notional mass nouns such as *unu* ‘water’ (Faller and Hastings, 2008: 297–8):

- (39)
- a. *sapanka* *runa*
each person
‘every person’

b. *sapanka* *unu*
each water
‘each bottle/kind of water’

(Cuzco Quechua)

(adapted from Faller and Hastings, 2008: 297–8, (33b), (36b))

Even though this may suggest at first sight that *sapanka* is compatible with mass nouns, this is only apparently the case: Faller and Hastings explicitly specify that if the noun *unu* ‘water’ is used with *sapanka*, it must have a count interpretation. In this respect, *sapanka* differs from non-distributive universal quantifiers. As in the case of *all* in English and *suǒyǒu* ‘all’ and *quánbù* ‘all’ in Mandarin, these are not sensitive to the count–mass distinction. Contrary to the example in (39), where the distributive universal quantifier *sapanka* ‘each’ is used, the noun *unu* ‘water’ does not need to obtain a count interpretation, when combined with the expressions *llapan* ‘all’, *tukuy* ‘all’, or *lliw* ‘all’:

- (40)
- llapan/tukuy/lliw* *runa/* *unu*
all person/ water
‘all persons/water’

(Cuzco Quechua)

(adapted from Faller and Hastings, 2008: 297, (33a), (36a))

Based on this small sample, it can be concluded that the pattern illustrated in (35) for English, correlating distributivity of the quantity expressions and a count interpretation of the nominal complement of the quantity expression, can be found in unrelated and typologically distinct languages.

If distributive quantifiers are more selective than non-distributive ones with respect to mass–count properties of the noun or nominal phrase they modify, this can be seen as further evidence for Gil's (1995) claim that distributive universal quantifiers are marked while non-distributive universal quantifiers are not, as motivated by two further universals. First, if in a language a distributive and a non-distributive universal quantifier are morphologically related, the distributive universal quantifier is derived from the simple, non-distributive universal quantifier, and not the other way around (*Universal 3*). Second, if a language has only one type of universal quantifier, it lacks a separate distributive universal quantifier (*Universal 4*). In this latter case, a commonly found strategy of creating distributive universal quantifiers is based on number marking, as illustrated for Modern Hebrew in the following examples:

- (41)

- a. kol haʔanašim hitʔasfu ʕim šaḥar. (Modern Hebrew)
all the-man-PL:M REFL-gather-PAST-3:PL with dawn
'All men gathered at dawn.'
- b. *kol iš hitʔasef ʕim šaḥar.
all man REFL-gather-PAST-3:SG:M with dawn (Gil, 1995: 331, (19))

(42)

- a. kol haʔanašim saḥvu šaloš mizvadot. (Modern Hebrew)
all the-man-PL:M carry-PAST-3:PL three suitcase-PL:F
'All men carried three suitcases.'
- b. kol iš saḥav šaloš mizvadot.
all man carry-PAST-3:SG:M three suitcase-PL:F
'Each man carried three suitcases.' (Gil, 1995: 331, (20))

p. 93 As these examples show, the use of *kol* with a singular complement is prohibited in the context of a collective predicate but possible in the context of a distributive predicate, illustrating that the shift from a plural to a singular complement is correlated with distributivity.

Based on these data and the universal in (34) one might expect that there exists a strong relation between the presence of plurality and the absence of distributivity. This turns out not to be the case in all languages with plural morphology on nouns, as can be illustrated by data from Cuzco Quechua. Unlike English *every* and *each*, *sapanka* 'each' can be used with a plural marked noun, as in (43):

(43)

- Sapanka llama-kuna puñu-sha-nku. (Cuzco Quechua)
each llama-PL sleep-PROG-3PL
'Each llama sleeps.' (Faller and Hastings, 2008: 296, fn. 42)

Still, the meaning of *sapanka* can be shown to be distributive, as it turns out that *sapanka* is always strange in combination with the distributive marker *-kama*, whether the plural marker is present or not.

(44)

- ?Sapanka llama-(kuna) yuraq-kama. (Cuzco Quechua)
each llama-PL white-DISTR
'Each llama is (*each) white.' (Faller and Hastings, 2008: 294, (28d))

The question mark reflects the fact that some speakers qualify the sentence as acceptable, even though the use of the distributive marker *-kama* is perceived as redundant, while others reject the combination of *sapanka* and the distributive marker. The difference between the pattern in Modern Hebrew and the one in Cuzco Quechua may well be related to the obligatory character of plural marking in Modern Hebrew as opposed to its optional use in Cuzco Quechua, which suggests that nouns without plural marking in Cuzco Quechua are number neutral rather than semantically singular.

To conclude, the preceding overview of the distinction between distributive and non-distributive universal quantifiers shows that distributivity, number marking, and sensitivity to the count–mass distinction interact. Distributive quantifiers are in most cases universal, and always marked. They can only be interpreted in the context of nouns that have a count interpretation, similarly to cardinal quantity expressions. In languages with obligatory number marking and a grammaticalized singular–plural opposition, they typically combine with singular nouns. Non-distributive universal quantity expressions are unmarked. They are compatible with both mass nouns and count nouns, and, as such, resemble non-cardinal quantity expressions.

4.6 Quantity expressions in the verbal domain

Quantity expressions that are used in the nominal system can in some cases also be used in the verbal domain (Obenauer, 1984, 1994; Doetjes, 1997, 2006, 2008; Wellwood et al., 2012). This phenomenon can be observed in particular for non-cardinal quantity expressions, as illustrated in (45) (see also Chapter 15 in this volume):

(45)

- a. They danced a lot.
- b. a lot of books/soup

The type of distribution illustrated in (45) is not unexpected given parallels between nominal and verbal predicates. As discussed by Mourelatos (1978), Bach (1986), and Krifka (1986), activities such as *to dance* are similar to mass nouns. Accomplishments and achievements, on the other hand, are similar to count nouns. Under the assumption that accomplishments and achievements correspond to number-neutral predicates, it is not surprising that these predicates can be modified by non-cardinal quantity expressions, suggesting that in languages that show this type of distribution for non-cardinal quantity expressions, these quantity expressions are not sensitive to the distinction between nominal and verbal predicates.

In the context of non-cardinal quantity expressions, a plural interpretation typically obtains in the context of a count verbal predicate, similarly to what can be observed in the nominal system:

(46)

- a. They met each other a lot.
- b. He read a lot.
- cf. a lot of pens
- cf. a lot of soup

As in the case of *a lot of pens*, (46a) is interpreted as a plurality; in this case a plurality of encounters. In the context of a mass predicate like *to read*, a global quantity reading obtains.²⁴ The examples in (45) and (46) illustrate that the parallels between nominal and verbal predicates can be reflected by the behaviour of non-cardinal quantity expressions. They also show that no number markers or classifiers are involved in these cases. In the remainder of the section, the discussion will be extended to cardinal quantity expressions in relation to classifiers (section 4.6.1) and cross-linguistic generalizations (section 4.6.2).

4.6.1 Cardinal quantity expressions and classifiers in the verbal domain

Whereas non-cardinal quantity expressions such as *a lot*, *more*, and *less* can directly modify verbal predicates in English, *three* and *several* cannot. In order to use them as modifiers of verbs, a measure word needs to be inserted:

(47)

They danced three *(times).

The obligatory use of the measure word raises the question whether this can be seen as an equivalent of classifier insertion in the nominal domain. At first this idea seems appealing: given the lack of number marking on verbs, the verbal domain in English might be similar to the nominal domain in a language such as Mandarin as illustrated above: non-cardinal quantity expressions combine directly with the noun (29),

while cardinal quantity expressions trigger insertion of a classifier (3). However, a closer look at the data shows that this comparison makes wrong predictions, as demonstrated in Doetjes (2006, 2008) on the basis of French *beaucoup* ‘a lot’. In particular, the combination of the cardinal quantity expression and the measure word does not interact with the verb phrase in the way that would be expected based on the properties of adverbial modification by non-cardinal quantity expressions. In what follows the argument will be given based on French data from Doetjes (2008).

In the nominal domain, non-cardinal quantity expressions combine with nouns that have cumulative reference, and they are difficult to interpret if the predicate corresponds to a singular predicate. An example of a necessarily singular predicate is the predicate *acheter deux kilos d’olives* ‘to buy two kilos of olives’. The noun phrase *deux kilos d’olives* ‘two kilos of olives’ is quantized rather than cumulative, and this property is inherited by the verbal predicate *acheter deux kilos d’olives* (Verkuyt, 1972, see for instance Krifka, 1992). Two events of buying 2 kilos of olives do not constitute an event of buying 2 kilos of olives, as the combined event would involve the buying of 4 rather than 2 kilos of olives. The only plural events that could be involved are events of buying the same 2 kilos of olives several times. The unacceptability of the French example in (48) can thus be derived from the fact that the verbal predicate is inherently singular:

(48)

#Isabelle	a	beaucoup	acheté	deux kilos	d’olives.	(French)
Isabelle	has	a.lot	bought	two kilos	of olives	
‘She bought two kilos of olives a lot.’						(Doetjes, 2008: 151, (25))

Contrary to *beaucoup*, a numeral plus the element *fois* ‘times’ can function as a modifier of this type of verb phrase (in spoken French *trois fois* would rather come at the end of the sentence):

(49)

Elle	a	acheté	trois fois	deux kilos	d’olives.	(French)
she	has	bought	three times	two kilos	of olives	
‘She bought two kilos of olives three times.’						(Doetjes, 2008: 155, (31))

p. 96 As a modifier of the verb phrase, *trois fois* has scope over *deux kilos d’olives* and introduces a distributive reading. The problem observed in the previous example does not occur, suggesting that the relation between *trois fois* and the verb phrase is different from the one between *beaucoup* and the verb phrase. This is not expected given what we know from the nominal domain. The French examples above illustrate a general pattern: adverbial modifiers of the form *n times* take scope over quantified noun phrases in the VP while adverbial non-cardinal quantity expressions normally behave in the way illustrated for *beaucoup* above.²⁵

A second argument confirming the different relation between *times* and a VP and classifiers or measure expressions and nouns can be made on the basis of a comparison between *times* and *pieces*. Taking *times* to be a classifier-like item in English, the nominal counterpart it is most closely related to is the unit term *piece* as in *two pieces of furniture*, where *piece* is obligatorily inserted in the context of a numeral. As illustrated by the examples in (50), there is no complete parallel between *n times VP* and *n pieces NP* (see Doetjes, 2008: 155):

(50)

- a. He answered three times in a different way.
- b. three pieces of furniture from a different period

In the example in (50a), *different* can be interpreted in two ways: the answers can be different from each other or they can be different from another answer that has been mentioned in the preceding context (see for instance Carlson, 1987). In the example in (50b), only the second type of reading is possible: the three pieces of furniture are from a period that is not the same as some contextually mentioned period. The reading according to which the pieces come from different periods, that is the distributive reading, is not available (unless a plural is used, in which case the reading does not result from wide scope). In other words, while *n times* takes scope over a c-commanded quantified noun phrase within the VP, *n pieces* does not take scope over a c-commanded quantified noun phrase within the NP. This strengthens the conclusion that the use of *times* in combination with a cardinal quantity expression as a modifier of verb phrases is not directly comparable with the use of classifiers and classifier-like elements in the nominal system.

4.6.2 Cross-linguistic generalizations

From a cross-linguistic point of view, the patterns discussed above can be found in various languages of different language families. Besides being common in Germanic and Romance, they can also be observed in for instance Hungarian, Moroccan Arabic, and Indonesian (Doetjes, 2006). The relevant Indonesian examples are given in (51):

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(51)

- a. banyak buku/teh (Indonesian)
a.lot book/tea
'A lot of books/tea.'
- b. Yanto banyak mengunjungi Dewi.
Yanto a.lot ACTIVE.visit Dewi
'Yanto visits Dewi a lot.'
- c. Yanto sudah 2 kali membeli 2 kilo buah zaitun.
Yanto already 2 times ACTIVE.buy 2 kilo fruit olive
'Yanto bought two kilos of olives twice.'
- d. *Yanto sudah banyak membeli 2 kilo buah zaitun.
Yanto already a.lot ACTIVE.buy 2 kilo fruit olive
(Doetjes, 2006: 718, (1), (5))

Similarly, the non-cardinal quantity expressions *heta* 'a lot' in Paraguayan Guaraní (Tupi, Frutos, 2016) is also reported to combine with mass nouns, with count nouns and with verbs:

(52)

- a. Oĩ heta y ko'ape. (Paraguayan Guaraní)
oĩ-ø heta y ko'a-pe
have-NFUT heta water here
'There is a lot of water here.'
- b. Oĩ heta apyka ko'ape.
oĩ-ø heta apyka ko'a-pe
have-NFUT heta chair here
'There are a lot of chairs here.'
(Frutos, 2016: 295, (4.86))
- c. Juan omba'apo heta.
Juan o-mba'apo-ø heta
Juan 3-work-NFUT heta
'Juan works/worked a lot.'
(Frutos, 2016: 297, (4.90))

However, it is not the case that non-cardinal quantity expressions always permit adverbial uses, as illustrated by Mandarin *hěn duō* ‘a lot’ (see also (30)):

(53)

- a. *Háng gōng zuò le hěn duō. (Mandarin)
 Háng work PFV a.lot
- b. Háng gōng zuò le shí xiǎo shí.
 Háng work PFV ten hour
 ‘Háng worked for ten hours.’
- c. Háng zuò le hěn duō gōng zuò.
 Háng do PFV a.lot work (Hang Cheng, p.c.)

p. 98 As shown in the first two examples, *hěn duō* cannot be used as an adverbial modifier, unlike, for instance, *shí xiǎo shí* ‘ten hours’. In order to obtain the type of reading that is intended, a nominal structure needs to be used, as in (53c), where *hěn duō gōng zuò* ‘a lot of work’ is a nominal structure. Even though the use of non-cardinal quantity expressions as verbal modifiers is not universal, its occurrence in typologically different languages shows that the distributional pattern exemplified by *a lot* is not accidental. Moreover, the semantic similarity between nominal and verbal predicates may very well be at the basis of the cross-linguistic occurrence of this pattern.

As for cardinal quantity expressions, the structure with *times* is quite common and occurs in typologically distinct languages. As the Hausa (Chadic) example in (54) shows, the use of *sàù ukù* is incompatible with pluractionality on the verb (see Součková, 2011).

(54)

- Sun ci/ *cicci jarràbàawaa sàù ukù. (Hausa)
 they eat/eat-PL exams time three
 ‘They passed exams three times.’ (Malami Buba, p.c.)

A second strategy that is used in Hausa, which is also found in other languages, makes use of nominal modification in a cognate object structure (Newman, 2000). In this case, pluractional morphology is not allowed either:

(55)

- a. Taa zàagee shì zaagii ukù. (Hausa)
 she insult him insulting three
 ‘She insulted him three times.’ (adapted from Newman, 2000: 387)
- b. *Taa zàagee shì zàzzagii ukù.
 she insult him insulting-PL three (Malami Buba, p.c.)

In the Eskimo–Aleut language West Greenlandic, a special auxiliary *-riar* is used to combine a numeral with a verbal predicate (Fortescue, 1984; Van Geenhoven, 2004):

(56)

- Marluriarluni quersortarpoq. (West Greenlandic)
 Marlu-riar-lu-ni quirsur-tar-puq
 two-do.times-INF-3SG.PROX cough-PL-IND.[-tr].3SG
 ‘He coughed twice.’ or ‘He repeatedly coughed, each time doing it twice.’
 (Fortescue, 1984: 283, cited in Van Geenhoven, 2004: 160, (64))

Again, the relation between verbal number and the numeral is not comparable to the relation between number marking and cardinal quantity expressions in inflectional number-marking languages such as English.

Another type of strategy is affixation. In Tagalog adverbial numerals are derived by means of prefixing *maka-* to numerals (Schachter and Otones, 1972: 214) and in the Carib language Kari'nya (Carib) the suffix *-mboto* is used (Hoff, 1968: 282).

Finally, the Tupi language Karitiana permits direct combination of an oblique numeral and a verbal predicate, as illustrated in the following example (Sanchez-Mendes and Müller, 2007):

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(57)

Sympomp	nakaponpon	João	sojxaty	kyn.
sympom-t	Ø-naka-pon-pon-Ø	João	sojxaty	kyn
two-OBL	3-DECL-shoot-REDUPL-NFUT	João	boar	POS
'João shot twice at the boar.'		(Sanchez-Mendes and Müller, 2007, (28))		

Pluractional morphology is not obligatory in this example (Ana Müller, p.c.; note the difference with the Hausa examples above in this respect). In Karitiana most quantity expressions (e.g. *kandat* ‘a lot’) are always adverbial, nominal quantification being obtained indirectly by means of adverbial quantification. As pointed out by Müller et al. (2006), numerals are special in this respect, because they can directly modify nouns. Next to their adverbial use exemplified in (57) they also occur preminally (note that the oblique marker *-t* is also present in this case). The exact status of numerals in Karitiana is an issue for further research, as well as the question how common the adverbial use of numerals is cross-linguistically.

4.7 Conclusions

Three types of strategies are commonly found for quantity expressions in the context of noun phrases: number marking on the noun (usually plural marking), classifier insertion, and direct combination of an unmarked noun and a quantity expression. The type of strategy that is chosen depends not only on the language, but also on the quantity expression: within the same language, different strategies can be used for different quantity expressions.

Quantity expressions may also introduce conditions on the lexical meaning or grammatical properties of the nouns they combine with, in particular concerning countability. Cardinal quantity expressions (cardinal numerals and expressions such as *several* and *many*) impose count meaning and/or grammar. Non-cardinal quantity expressions such as *a lot* and *more or less* are indifferent with respect to the type of meaning of the noun they combine with. A small subclass of this latter type of expression is restricted to mass nouns, which may be due to a blocking effect (cf. *much* vs *many* and *a little* vs *a few*). Differences between cardinal and non-cardinal quantity expressions can be observed in typologically distinct languages and are not restricted to languages in which the mass-count distinction is marked by inflectional number.

The semantic literature makes different claims about the number properties of nouns that are modified by cardinal numerals. Some of these claims have been discussed in detail in the preceding sections. On the one hand, Ionin and Matushansky (2006) argue that a noun modified by a numeral is always semantically singular. If the noun is realized as a plural noun, as in *two books*, plural morphology is claimed to be the result of plural agreement of a semantically singular predicate. On the other hand, Bale et al. (2011a) argue that modification in the nominal and verbal domains is always restrictive and derive from this that a noun modified by a numeral other than the numeral for ‘one’ cannot be a singular. This implies that unmarked nouns modified by numerals need to be analysed as number neutral from a semantic point of view.

p. 100 Non-cardinal quantity expressions normally combine with nouns that have cumulative reference (unless a very specific interpretation is obtained—as in (23)). Comparing the distribution of nouns in combination with cardinal quantity expressions and non-cardinal quantity expressions, two types of pattern emerge: in some languages, such as Hungarian, both types of expressions are incompatible with plural nouns. In other languages, such as Finnish, cardinal quantity expressions combine with singular count nouns, while non-cardinal quantity expressions require plural marking on a noun if it has a count interpretation. Non-cardinal quantity expressions are compatible with mass nouns as well as count nouns. As mass nouns are semantically similar to plural and number-neutral count nouns and quite different from singular count nouns, these expressions are expected to be compatible with number-neutral or plural count nouns rather than with semantically singular count nouns. The two patterns that are found suggest that cardinal quantity expressions may vary in the type of nouns they combine with. While the pattern in Hungarian is predicted to occur if the unmarked noun is number neutral, the pattern in Finnish can be interpreted as an indication that the unmarked noun is semantically singular, thus explaining the requirement of a plural form in the context of a non-cardinal quantity expression.

Universal quantifiers show a similar distinction between expressions that can only be combined with a noun that has a count interpretation on the one hand, and ones that are not sensitive to the mass or count properties of nouns on the other. This distinction correlates with the distinction between distributive and non-distributive universal quantity expressions (see in particular Gil, 1995), which in turn correlates with number properties of these nouns. In languages such as English, distributive universal quantifiers (e.g. *every*) combine with singulars, while non-distributive ones (e.g. *all*) combine with plurals and mass nouns. As data from Cuzco Quechua show, the correlation between the absence of plural marking and distributivity does not necessarily hold in languages with optional plural marking. It could be the case that the singular requirement for distributive quantity expressions is restricted to languages with obligatory number marking.

The last topic discussed in this chapter concerned the distribution of nominal quantity expressions in the verbal domain. This is a domain where more research is needed, but a few tentative conclusions can be drawn. Non-cardinal quantity expressions in unrelated languages combine with verbal predicates in ways that are similar to the ways in which they combine with nominal predicates. For cardinal quantity expressions, classifier-like elements are commonly inserted (e.g. *times* in English). However, the behaviour of the resulting verbal structures is not parallel to that of nominal structures with classifiers. In general, cardinal quantity expressions seem less likely to have a parallel behaviour with nominal and verbal predicates than non-cardinal ones.

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Notes

- 1 I will abstract away from cross-linguistic differences that are not directly connected to number, such as the position of the quantity expression with respect to the noun and the presence of linkers, prepositions, or case markers and the exact grammatical status of the expression (adjectival, nominal, adverbial, or in some cases even verbal—see Li, 2006). In some languages, the equivalent of nominal quantification is obtained via adverbial quantity expressions that modify the verb phrase (see Bach et al., 1995). This phenomenon will be briefly addressed in section 4.6.

- 2 Following common practice in the literature on numeral classifiers, I use CL as a gloss for CLASSIFIER, rather than the Leipzig gloss CLF.
- 3 Note that measure words may lack number marking, even in languages that normally require number marking on nouns, as illustrated by *two head of cattle* (see, among many others, Klooster, 1972; Doetjes, 1997; Vos, 1999; Rothstein, 2010b, 2017).
- 4 Note that these nouns trigger singular or plural agreement depending on their interpretation. Based on this, they could be analysed as nouns that have a singular?plural opposition despite the impossibility of (overt) plural marking.
- 5 Bare nouns can be shown to be kind denoting by means of kind predicates, such as *to be widespread*. Kind predicates describe properties of kinds rather than of individuals. Whereas a kind can be widespread, individual instances of the kind cannot (cf. *Mice are widespread* vs. **A mouse is widespread*; see Carlson, 1977b).
- 6 This does not mean that they behave in exactly the same way in all contexts. See Chapter 33 in this volume, for an illustration of differences between inclusive plurality and number neutrality in one and the same language.
- 7 For discussion of more complex numeral systems and the relation between numerals in natural language and number representation in cognition, see, among others, Dehaene (2011), Hurford (2001) and Wiese (2003).
- 8 The non-overlap condition is not necessary for atoms, as these do not overlap by definition. It is necessary however for the compositional semantics of numerals: in order to create a sum corresponding to 200 books, I need to join two non-overlapping sums of 100 books.
- 9 A partition is a special type of cover. A set of individuals S is a cover of a plural individual x if x is the sum of all members of S . For the plural individual $a \oplus b \oplus c$, possible covers are for instance $\{a, b, c\}$, $\{a \oplus b, b \oplus c\}$ and $\{a \oplus b, c\}$. S is a partition Π of a sum (or plural individual) x , if S is a cover of x and the members x do not overlap. As a result, the cover $\{a \oplus b, b \oplus c\}$ is not a partition of the plural individual $a \oplus b \oplus c$, because its two members $a \oplus b$ and $b \oplus c$ overlap, while $\{a, b, c\}$ and $\{a \oplus b, c\}$ are partitions of $a \oplus b \oplus c$. See Chapter 17 in this volume for applications of covers in relation to verbal plurality.
- 10 Note that not everybody agrees with the claim that Hungarian and Turkish, in which the numeral only combines with the unmarked noun, lack inclusive plurals; see Farkas and de Swart (2010) for Hungarian, and Sağ (2017) and Renans et al. (2017) for Turkish. See Scontras (2014) for an alternative analysis of the same data, which does not rely on this claim.
- 11 The definition Krifka gives for $\llbracket [_{\text{Num}} \text{three}] \rrbracket$ is actually slightly more complex, as it generalizes over counting individuals (in (17) the individual bears) and counting subkinds (as in *three bears* in the sense of ‘three types of bears’) (see Krifka, 1995a for further details).
- 12 In this regard, *a lot* differs from *many*, which is necessarily interpreted with respect to a cardinal scale—see Hackl (2001).
- 13 This reading is different from so-called grinding (Pelletier, [1975] 1979), as we are not talking about the (ground) stuff a house is made of, but of the size of a house (as in *a bigger house*).
- 14 A question that arises when the alternative approach is adopted, is why *many* does not rule out the use of *a lot* in the context of count nouns. In other words, why would *much* be blocked, while *a lot* is not? Even though this question is not easy to answer, it can be shown that blocking processes in the domain of quantity/degree expressions can be restricted to specific pairs of lexical items in other cases as well. For instance in French, while *si* ‘so’ can be shown to block the use of *tant* ‘so much/many’ with adjectives (*si/*tant petit*), it does not block the use of *tellement* ‘so (much/many)’ (*tellement petit*); see Doetjes (1997, 2021) for ellipsis data showing that the impossibility of **tant petit* is likely to be due to blocking by *si*.
- 15 The alternative would be to stipulate that *sok* is ambiguous between a cardinal quantity expression combining with a singular predicate and a non-cardinal quantity expression restricted to mass nouns. Given the cross-linguistic distribution of non-cardinal quantity expressions in typologically distinct languages, a uniform analysis similar to the one for *a lot* in (22) is much more likely. See also Farkas and de Swart (2010: 6:10), who argue against treating *gyerek* in (23a) as a singular predicate based on the observation that expressions such as *sok gyerek* are not distributive, as they are compatible with collective predicates. I will come back to the relation between singularity and distributivity in section 5.3.
- 16 Bale et al. (2011a) and Bale and Khanjian (2014) offer several other arguments in favour of treating bare non-plural nouns in Western Armenian as number-neutral predicates.
- 17 I would like to thank Lisa Bylinina for drawing my attention to the possibility of combining numerals with singulative nouns.
- 18 With numerals up to ten, plural marking is used. The data from Tunisian Arabic illustrate the fact that numerals within a single language do not necessarily behave as a homogeneous class with respect to number marking. Under the hypothesis that plural marking is due to agreement, this would mean that numerals up to ten trigger plural agreement while higher numerals do not. Alternatively, one could argue that the two types of numerals have different semantic properties.
- 19 Note that some authors try to get rid of semantically singular predicates altogether. Farkas and de Swart (2010) argue within a bidirectional Optimality Theory approach that singular nouns both in English and in Hungarian are number-neutral predicates that can obtain a singular interpretation when they are in competition with plural forms. Differences in

the use of singular and plural forms between the two languages are attributed to language-specific constraint orderings. If semantically singular nominal predicates do not exist and all nominal predicates include both atoms and plural individuals, modification of a nominal predicate by a quantity expression is restrictive by default.

- 20 The element *de* is a predicate marker, which can also precede the noun in the context of a mensural classifier. In the original example of Zhang, *de* is marked as optional but several speakers indicated that they needed *de* in these examples. I wish to thank Hang Cheng, Jing Sun, Yang Yang, and Meng Zhang for their help with the data.
- 21 In the original example *hěn duō* is glossed as ‘very many’ and *hǒu² do¹* as ‘good many’, which reflects the internal morphology of the expression (*hěn* and *hǒu²* being expressions that indicate a high degree). In order to stress the fact that these are non-cardinal quantity expressions and are not restricted to count environments they are glossed as ‘a.lot’ here.
- 22 I will ignore a third type, which marks the distributive share rather than the distributive key (Gil, 1995: 344), and I will use the term distributive universal quantifier for what Gil calls distributive key universal quantifiers (e.g. *every*).
- 23 Note that abstract mass nouns such as *confidence* may be used with the distributive universal quantifier *every*. The larger distribution of abstract nouns can also be observed in the context of other quantity expressions, in particular in the context of a modifier (see Van de Velde, 1995; Tovená, 2001, 2003):

(i)

This landscape is of a *(great/breathtaking) beauty.

(ii)

- a. She still had *every* confidence in him as a mathematician. (Tovená, 2001: 576)
- b. *She had several/many confidences in him as a mathematician.

According to Tovená (2001, 2003), abstract nouns that have this property permit the identification of a unique entity, but as they do not define pluralities, they are incompatible with plural marking. The type of reading *every* gets in (iia) is similar to a maximal degree reading (‘the highest possible confidence’).

- 24 As in the case of *a lot of soup* nothing imposes a plural interpretation: the phrase is vague in terms of the number of subevents of reading, and does not exclude the possibility that there is one single reading event.
- 25 English *a lot* is exceptional in this respect (see Doetjes, 1997, 2006 for discussion).