Countability in Mandarin Chinese: Bridging Theory and Experiments

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Abstract

The present study conducts a systematic investigation of the encoding of countability in three grammatical systems in Mandarin Chinese, including the nominal system, the wh-pronoun system, and the quantifier system. We examine the countability of linguistic expressions from these three grammatical systems, comparing their countability in the presence/absence of a classifier. A common pattern is identified: classifiers determine the countability of linguistic expressions in the three systems. Our account thus represents a syntactic account of the count-mass in Chinese. We support this theoretical account with three sets of experimental data in Mandarin-speaking adults, and show that the data also militate against the opposing semantic account. The present study contributes new data to the investigation of the count-mass issue in Chinese, and the count-mass issue in general.

Keywords: countability, Mandarin Chinese, classifiers

1. Introduction

The count-mass distinction is traditionally regarded as a sub-categorization of nouns defined according to formal (morphological and syntactic) criteria, characterizing count nouns and mass nouns with the interpretation and distribution of associated determiners and quantifiers (See Jespersen, 1924, pp. 198-200; Bloomfield, 1933, pp. 205-206). The discussion on this grammatical category has been further developed to
consider various interactions between ontological, conceptual, and linguistic factors, incorporating the research findings from the fields of psycholinguistics, philosophy, and cross-linguistic research (e.g., Quine, 1960; McCawley, 1975; Pelletier, 1979, 2012; Macnamara, 1982; Gordon, 1982; Gathercole, 1986; Bloom, 1990; Chierchia, 1998, 2010; Borer, 2005; Barner & Snedeker, 2005, 2006; Bale & Barner, 2009; Massam, 2012). Psychologists, philosophers, and linguists widely agree that the concepts of count and mass form part of a universally shared cognitive capacity, but there is disagreement on how the concepts of count and mass are grammatically encoded within a language, or cross-linguistically (Ghomeshi & Massam, 2012). Particularly, it is controversial how the expression of countability is affected and determined by syntactic and semantic factors.

The investigation of the expression of countability is particularly important for languages like Mandarin Chinese (referred to as Chinese hereafter). In Chinese, nouns are not systematically marked with grammatical count-mass distinction markers like in some Indo-European languages (e.g., English). Rather, the expression of countability is closely related to the Chinese classifier system (Krifka, 1995; Cheng & Sybesma, 1999; Borer, 2005; Zhang, 2012, 2013; Li, 2013), which is typologically different from other formal means such as determiners, quantifiers, and plural morphology that are used to mark countability in English. The typological features of Chinese nouns and classifiers bring about a heated debate with regard to the expression and representation of countability in this language. Some scholars argue for a semantic account and divide Chinese nouns into count nouns and mass nouns, based on the ontological properties of their denotation (Chao, 1968; Fung, 1991; Doetjes, 1997; Cheng & Sybesma, 1998, 1999, 2005; Cheng, Doetjes, & Sybesma, 2008; Sybesma, 2007; Cheng, 2012; Liu, 2014). Other scholars refute the semantic count-mass account, and instead resort to a syntactic account to characterize countability in the Chinese nominal system; the syntactic account generally holds that the Chinese classifier system shapes countability of Chinese nouns (Hansen, 1983; Graham, 1989; Bach, 1989; Harbsmeier, 1991; Krifka, 1995; Chierchia, 1998; Bo, 1999; Borer, 2005; Huang, 2009; Huang & Lee, 2009; Rothstein, 2010). Thus, an unresolved problem lies in which account fares better in explaining the expression of countability in Chinese.

The syntactic versus semantic account debate has so far focused on the Chinese nominal system, and little is known about the expression of countability beyond this grammatical system. However, the count-mass issue is a complex linguistic
phenomenon that is not just involved in the nominal system, but also in other grammatical systems (Chierchia, 1998), such as the *wh*-pronoun system (e.g. *how many* versus *how much*) and the quantifier system (e.g., *many* and *much*) in English. These systems are severely understudied in Chinese, so very little is known about how the mass-count distinction is encoded in each system, and which account can better capture these data. Therefore, it is necessary to conduct a comprehensive investigation on the encoding of countability in Chinese across multiple grammatical systems. Moreover, it is worthwhile to examine whether there exists uniformity between the Chinese nominal system and other grammatical systems in their encoding of countability. This would allow us to look into the count-mass issue in Chinese from a broader perspective.

In the present study, we attempt to explore the unresolved issues of the Chinese count-mass issue by conducting a systematic investigation on countability of linguistic expressions from three systems, including the nominal system, the *wh*-pronoun system, and the quantifier system. We have two objectives. First, we aim to investigate how the presence/absence of a classifier affects and determines countability of linguistic forms in the above mentioned three systems. The theoretical accounts will be confirmed via experimental data. We will also examine whether the encoding of countability between the three grammatical systems is homogenous. This comprehensive examination of countability across the three systems will expand our understanding of countability in Chinese, inviting us to explore the issue from a broader theoretical perspective. Second, we will attempt to adjudicate the syntactic versus semantic disputes on countability in Chinese. The proposal we present is syntactic, and we will show how the syntactic account fares better than the semantic account.

The remaining parts of the paper are arranged as follows. Section 2 introduces the debate on the syntactic versus semantic accounts of countability in Chinese. Sections 3-5 examine countability of linguistic forms from the nominal system, the *wh*-pronoun system, and the quantifier system. In each of these three sections, we first discuss the theoretical issues, and then introduce empirical data. Section 6 discusses how the empirical data help adjudicate the syntactic versus semantic disputes, and contributes new data to the study of the count-mass in general. Section 7 concludes the paper.
2. Syntactic versus Semantic Accounts of Countability in Chinese

In this section, we examine in more details how the syntactic and semantic accounts differ in their characterization of classifiers and nouns.

Consider first the semantic account. The semantic account contends that countability in Chinese is specified at the level of lexical items, and nouns are subcategorized into count nouns and mass nouns based on their denotation (Doetjes, 1997; Cheng & Sybesma, 1998, 1999; Cheng, Doetjes, & Sybesma, 2008; Cheng, 2012). According to the semantic account, nouns like ping-guo ‘apple’ are count nouns, because they denote entities that “present themselves naturally in discrete, countable units” (Cheng & Sybesma, 1998, p. 385). On the other hand, nouns like shui ‘water’ are mass, because their denotation does not present itself naturally in discrete entities. The semantic account is explicitly presented in Cheng, Doetjes, and Sybesma (2008, p. 53) (see also in Cheng, 2012, p. 218). Consider their examples as shown in (1) and (2).

(1) Women zuotian chi le henduo pingguo
   we yesterday eat Asp many apple
   ‘We ate many apples yesterday.’ (NOT: much apple)

(2) Women zuotian chi le henduo bingqilin
   we yesterday eat Asp much ice cream
   ‘We ate much ice cream yesterday.’

   (Cheng, Doetjes, & Sybesma, 2008, p. 53, example (9))

Cheng, Doetjes, and Sybesma claim that ping-guo ‘apple’ is a count noun, and it can only receive an individual-denoting reading. On the other hand, they state that the bare noun bingqilin ‘ice-cream’ is a mass noun, receiving only a substance-denoting reading. Therefore, when these two nouns appear with the quantifier hen-duo, which is semantically equivalent to English ‘a lot’, they are assigned a count use and a mass use respectively. In particular, hen-duo ping-guo is glossed as ‘many apples’ (an individual-denoting reading) (see (1)), while hen-duo bing-qi-lin is glossed as ‘much ice cream’ (a substance-denoting reading) (see (2)). Cheng, Doetjes, and Sybesma emphasize that hen-duo ping-guo in (1) cannot be interpreted with ‘much apple’, which is a substance-denoting reading. We will revisit Cheng, Doetjes, and Sybesma’s
As for the characterization of Chinese classifiers, Cheng and Sybesma (1999) propose that individual classifiers (or ‘count classifiers’ in their terminology) “name” the inherent unit of counting that is encoded in the co-occurring count nouns, or “make the semantic partitioning of count nouns syntactically visible” (p. 520) (cf. Doetjes, 1997). On the other hand, other types of classifiers (or ‘massifiers’ in their terminology) “create” units of counting.

In contrast to the semantic account, the syntactic account generally holds that classifiers determine the countability of nouns (Hansen, 1983; Graham, 1989; Bach, 1989; Harbsmeier, 1991; Krifka, 1995; Chierchia, 1998; Bo, 1999; Borer, 2005, Huang, 2009; Huang & Lee, 2009; Rothstein, 2010; Zhang, 2013). A strong syntactic account is offered by Borer (2005), wherein nouns are unmarked for either count or mass in their lexical specification, and furthermore, both count nouns and mass nouns are grammatically constructed. This account is argued to hold for all languages. In English, the plural inflection and the indefinite article systems are the grammatical means to carve out individuality. For instance, in phrases such as *two apples*, the plural morpheme *-s* imposes the requirement that the noun *apple* must denote individual apples. Similarly, in Chinese, classifiers are the grammatical means to specify the countability of associated nouns. For instance, individual classifiers such as *ge* in the phrase *liang ge ping-guo* ‘two CL *ge* apple’ require that the associated noun *ping-guo* must denote individuals (see Huang, 2009; Huang & Lee, 2009 for similar ideas). In short, in Borer’s syntactic account of countability, classifiers in Chinese work in parallel with the plural morphology and the indefinite article in English in their grammatical function of carving out individuality.

To sum up, the syntactic account and the semantic account differ in their characterization of nouns and classifiers in terms of their contribution to countability. In the semantic account, countability is realized at the lexical specification, such that the ontological properties of nouns determine their countability, and count and mass nouns select different classifiers. In the syntactic account, however, classifiers play the decisive role of specifying the countability of co-occurring nouns.

In the following sections, we will adjudicate these two opposing accounts with empirical data. To do this, we will first look into three grammatical systems in Chinese: the nominal system, the *wh*-pronoun system, and the quantifier system. A common pattern is proposed to characterize the encoding of countability in these
systems: classifiers determine the countability of linguistic expressions from these three systems. These are the main ideas in Sections 3-5. In each of these sections, we first introduce the theoretical analysis, and then support the analysis with experimental data. Then Section 6 offers a summary of the three sets of experimental data, followed by a discussion of how the empirical data give support to the syntactic account and militate against the semantic account. In this section, we also discuss the universal significance of the present study on the study of the count-mass in general. Section 7 concludes the paper.

3. Countability in the Nominal System

In this section, we present our account of countability in the nominal system first, and then offer experimental evidence in its support.

We begin with our theoretical side. In the nominal system, classifiers determine the countability of their co-occurring nouns. This can be illustrated by discussing the interpretive differences between bare nouns and two types of classifier-bearing structures. First consider the interpretation of bare nouns. In the absence of a classifier, bare nouns in Chinese are neutral in countability, so they can convey both count and mass readings. In this regard, we say bare nouns are underspecified in countability (cf. Borer, 2005; Bale & Barner, 2009; Pelletier, 2012). This is illustrated with the interpretation of the bare noun ping-guo ‘apple’ in sentence (3) (Huang, 2009, p. 40). It can denote individual apples, individual apple chunks, and apple substance presented as mashed purée. Moreover, ping-guo can denote apple kinds, as shown in sentence (4).

(3) *Panzi li you pingguo*  
plate in exist apple  
a. ‘There is/are an apple/apples on the plate.’  
b. ‘There is/are an apple chunk/apple chunks on the plate.’  
c. ‘There is some mashed apple on the plate.’

(4) *Pingguo tian, juzi suan*  
apple  sweet orange sour  
‘Apples are sweet, while oranges are sour.’

The multiple readings of ping-guo ‘apple’ as shown above indicate that bare nouns
denoting inanimate entities are underspecified in countability. Moreover, bare nouns that can denote animate entities are also underspecified in countability. This can be shown by the multiple interpretations of the bare noun ji ‘chicken’ in examples (5)-(7). Ji receives the singular or plural individual-denoting readings in (5), a ‘kind-denoting’ reading in (6), and a ‘substance-denoting’ reading in (7).

(5) Ji zai zhao chongzi
   Chicken Asp look-for worm
   (i) The chicken is looking for worms.
   (ii) The chickens are looking for worms.

(6) Ji shi burudongwu
   chicken Aux mammal
   ‘Chickens are mammals.’

(7) Wo xihuan chi yu, danshi bu xihuan chi ji
   I like eat fish but not like eat chick
   ‘I like to eat fish, but I don’t like to eat chicken.’

The underspecification in countability is resolved when a classifier is added. This brings us to the interpretation of classifier-bearing structures. There are two ways to attach a classifier to nouns. One is to formulate an N-CL compound. The countability of N-CL compounds is thoroughly discussed in Zhang (2013, ch7). The classifier in this kind of compound carves out individuality. This is illustrated in (8).

(8) Panzi li you pingguo-kuai
   plate in have apple CLchunk
   ‘There is/are apple chunk(s) on the plate’

(8) shows that, the presence of classifier kuai ‘chunk’ makes the N-CL compound ping-guo kuai ‘apple-CL’ unambiguously denote ‘apple chunk(s)’. N-CL compounds are common in Chinese. According to Zhang (2013, p. 258), any type of Chinese classifiers may follow a noun, forming an N-CL compound. More examples of N-CL compounds are given in (9) below.

(9) shui-di ‘water-CLdrop’: ‘drop(s) of water’
Moreover, the underspecification in countability is also resolved when a classifier is added to its preceding nouns, and forms a CL-N structure. To illustrate, consider (10)-(11).

(10)  Panzi li you ge pingguo
       plate in exist  CL apple
       ‘There is an apple on the plate.’

(11)  Panzi li you kuai pingguo
       plate in exist  CL apple
       ‘There is an apple chunk on the plate.’  (Huang, 2009, pp. 41-42)

In (10), with the presence of an individual classifier ge, only one reading is possible: ‘there is an individual apple object on the plate’. In (11), in which a partitive classifier kuai ‘chunk’ is used, the sentence unambiguously states that there is an apple chunk on the plate. Comparing (10) and (11), we see that different types of classifiers select different semantic values as involved in the interpretation of the associated noun.

Note that sentence (3) (with bare noun) on the one hand, and sentences (8) (with N-CL compound) and (10)-(11) (with CL-N structure) constitute three minimal pairs (i.e., (3) vs. (8); (3) vs. (10); (3) vs. (11)), with the presence or absence of a classifier. While the bare noun ping-guo in (3) conveys multiple readings, including individual-denoting reading, substance-denoting reading, and kind-denoting reading, the classifier-bearing phases or structures in (8) and (10)-(11) each convey only a specific reading as defined by the associated classifier. Thus, the interpretive differences in countability between these three groups of sentences containing ping-guo are attributed to the function of the relevant classifiers.

Crucially, our account is empirically supported with experimental data. Huang (2009) and Huang and Lee (2009) (Experiment 1) report that 12 Chinese-speaking adults were recruited to test the comprehension of seven nouns, including li ‘pear’, ping-guo ‘apple’, qingwa ‘frog’, yu ‘fish’, yizi ‘chair’, kuzi ‘pants’, and hua ‘picture’.
These nouns differ in their functional and ontological properties. In a picture verification task, these nouns were tested in two forms: (i) when they appear as bare nouns, and (ii) when they appear in the CL-N structure, as exemplified in (12) and (13). Each of these sentence structures was tested against the situations exhibiting whole pears (e.g., 14i), and the situations exhibiting pear chunks (e.g., 14ii, 14iii), as depicted in (14).

(12) *Dishang you lizi, zhuoshang ye you lizi* (bare noun)
ground-on exist pear table-on also exist pear
‘There is/are pear(s) on the ground, there is/are also pear(s) on the table.’

(13) *Dishang you ge lizi, zhuoshang ye you ge lizi* (CL-N)
ground-on exist pear table-on also exist pear
‘There is a pear on the ground, there is also a pear on the table.’

The results give support to our claim that the presence of a classifier determines the countability of nouns. In particular, the adults accepted the sentences containing bare nouns (e.g., sentence (12)) 98% of the time both in the whole object situations and in the partial object situations. This confirms that bare nouns are underspecified in countability. By contrast, their comprehension of sentences containing the CL-N structure (e.g., sentence (13)) differed in the whole object situations and in the partial object situations. In the whole object situations (e.g., 14i), they accepted the test sentences such as (13) 100% of the time, but in the partial object situations (e.g., 14ii, 14iii) they rejected them 55% of the time. The rejection of the CL-N test sentences in the partial object situations was attributed to the individuation requirement imposed by the individual classifier *ge* on the denotation of the noun *lizi* ‘pear’. Since sentences (12) and (13) constitute a minimal pair, and they differ only in the presence/absence of the individual classifier *ge*, the adults’ distinct interpretation of
the same nouns in these two structures hence clearly suggests that classifiers shape the countability of nouns in Chinese. In the next two sections, we will look into the interpretation of nouns in more experimental data when nouns co-occur with wh-pronouns and quantifiers. In those experiments, we will see the same nouns receive count readings or a mass reading depending on contextual information.

4. Countability in the Chinese wh-Pronoun System

In this section, we address how our account of countability can be extended to wh-pronouns, and can find empirical confirmation. To introduce countability in the Chinese wh-pronoun system, we compare two wh-pronouns, including duo-shao and duo-shao-ge. These two wh-pronouns differ in the presence/absence of the individual classifier ge. We will show that while the bare wh-pronoun duo-shao has both the ‘how many’ reading and the ‘how much’ reading, the classifier-bearing wh-pronoun duo-shao-ge has only the ‘how many’ reading. We will also introduce the countability of another classifier-bearing wh-pronoun, ji-ge, which has the same semantic interpretation as duo-shao-ge. The interpretive differences between the three wh-pronouns are attributed to the presence/absence of a classifier in these wh-phrases. We explain the details below.

Consider first the bare wh-pronoun duo-shao. Due to the absence of a classifier, the phrase duo-shao-N is underspecified in countability. To illustrate, consider sentence (15).

(15) Ni mai le duoshao pingguo?
    you buy Asp how-much/how many apple
    (i) ‘how much apple did you buy?’
    (ii) ‘how many apples did you buy?’

(15) is used to seek information on the quantity of apples a person just bought. Two possible interpretations are available for the hearer. First, the hearer may take the question as an inquiry of the amount of apples, a reading equivalent to ‘how much apple did you buy?’, as 15(i) shows. In this case, the interrogative duo-shao takes a ‘how much’ reading, and the noun ping-guo receives a substance-denoting reading. Therefore, to answer the question, the hearer may respond with liang gong-jin ping-
guo ‘two kilograms of apple’, in which the classifier gongjin specifies a measurement unit of apple substance. Alternatively, the hearer may take question (15) as an inquiry of the number of apples, a reading equivalent to ‘how many apples did you buy?’, as 15(ii) shows. In this case, he assigns a ‘how many’ reading to the wh-pronoun duo-shao, and the noun ping-guo receives an individual-denoting reading. On this interpretation, the hearer may respond with liang ge ping-guo ‘two apples’.

Next, we proceed to examine the countability of duo-shao-ge. It has an additional individual classifier ge, as compared to the bare wh-pronoun duo-shao. The presence of the individual classifier determines that this wh-pronoun receives only a ‘how-many’ reading, and its associated nouns receive only ‘individual-denoting’ readings. The interpretation of duo-shao-ge is equivalent to that of another classifier-bearing wh-pronoun, ji-ge. This can be shown by the examples in (16)-(17).

(16) *Ni mai le duoshaoge pingguo?*
    *you buy Asp how many apple*
    'how many apples did you buy?'

(17) *Ni mai le jige pingguo?*
    *you buy Asp how many apple*
    'how many apples did you buy?'

Both questions in (16) and (17) convey the reading ‘how many apples did you buy?’. On this reading, duo-shao-ge and ji-ge function like the English count quantifier *how many*, and the associated noun ping-guo denotes individual apples. Thus, only expressions that can denote individual objects, e.g., liang ge ping-guo ‘two apples’ can be used to answer these two questions.

Above are the interrogative uses of duo-shao, duo-shao-ge, and ji-ge in questions. Next, we show that their non-interrogative uses exhibit the same semantic interpretation. A typical non-interrogative use of wh-pronouns occurs in the bare conditional structure, as shown in (18)-(20) below. In bare conditionals, these wh-pronouns appear in pairs of pro-forms (represented as X in the sentences) in the antecedent and the consequent, with each pair denoting the same quantity under discussion (cf. Cheng & Huang, 1996; Lin, 1996; Chierchia, 2000).

(18) *Tu zi chi le duo shao luobo, Ma jiu chi le*
Rabbit eat Asp how many/how much carrot Horse then eat Asp
duoshao luobo
how many/how much carrot
(i) (lit.) ‘If Rabbit ate X amount of carrot, Horse then ate X amount of carrot.’ (Rabbit and Horse ate the same amount of carrot.)
(ii) (lit.) ‘If Rabbit ate X number of carrots, Horse then ate X number of carrots.’ (Rabbit and Horse ate the same number of carrots.)

(19) Tuzi chi le duoshao ge luobo, Ma jiu chi le duoshao ge luobo
Rabbit eat Asp how many carrot Horse then eat Asp how many carrot
(i) (lit.) ‘If Rabbit ate X number of carrots, Horse then ate X number of carrots.’
(Rabbit and Horse ate the same number of carrots.)

(20) Tuzi chi le jige luobo, Ma jiu chi le jige luobo
Rabbit eat Asp how many carrot Horse then eat Asp how many carrot
(i) (lit.) ‘If Rabbit ate X number of carrots, Horse then ate X number of carrots.’
(Rabbit and Horse ate the same number of carrots.)

Similar to the interrogative uses of *duo-shao* we saw earlier, the non-interrogative *duo-shao* in (18) is underspecified in countability, and is ambiguous with the ‘how many’ and ‘how much’ readings. On the ‘how much’ reading, this sentence states that Rabbit and Horse ate the same amount of carrot. In this case, the noun *luo-bo* ‘carrot’ receives a substance-denoting reading, and denotes the amount of carrot. Alternatively, on the ‘how many’ reading, this sentence means that Rabbit and Horse ate the same number of carrots. In this case, the noun *luo-bo* receives an individual-denoting reading, and denotes individual carrots. These two readings are equally accessible if this sentence is interpreted out of context. In distinct contexts, these two possible readings can be triggered separately, as will be shown shortly.

In contrast to the underspecification in countability in the case of the bare wh-pronoun *duo-shao*, the classifier-bearing wh-pronouns *duo-shao-ge* and *ji-ge* in (19) and (20) rigidly exhibit the ‘how many’ reading, and their associated noun conveys only an individual-denoting reading, namely, ‘Rabbit and Cat ate the same number of carrots’.

To wrap up, for both interrogative and non-interrogative uses of *duo-shao*, *duo-shao-ge*, and *ji-ge*, their countability is shaped by the presence/absence of a classifier. *Duo-shao* is underspecified in countability and can convey the ‘how much’ reading...
and the ‘how many’ reading. Thus, its co-occurring noun can convey count readings and mass readings. On the other hand, *duo-shao-ge* and *ji-ge* have only the ‘how many’ reading, and their associated noun exhibits count readings. Our analysis is confirmed with experimental data in our recent study (Huang, Ursini, & Meroni (under review)). The experimental details are summarized as below.

We used a truth value judgement task (Crain & Thornton, 1998)\(^1\) to test Chinese-speaking adults’ comprehension of the three types of non-interrogative, *duo-shao*, *duo-shao-ge*, and *ji-ge*, in bare conditionals, just like the sentences in (18)-(20). The experimental purpose was to examine whether native speakers of Chinese would assign the ‘how many’ reading and the ‘how much’ reading to the bare *wh*-pronoun *duo-shao* upon contextual manipulation, while assigning only the ‘how many’ reading to the classifier-bearing *wh*-pronouns *duo-shao-ge* and *ji-ge* no matter how the context is manipulated. To do this, we designed two contexts, the substance-oriented context and the individual-oriented context, for each of the three types of the sentences. The experimental design is summarized with two typical trials as in Figure 1 and Figure 2. More details are explained below.

Figure 1. Substance-oriented context for the *duo-shao/duo-shao-ge/ji-ge* experiment

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First consider the testing of the *duo-shao* sentences. In a typical trial illustrating the substance-oriented context, Rabbit ate two enormous carrots and he was very full, but Horse ate two tiny carrots and he was still hungry (Figure 1). In this kind of scenario, even though the number of carrots eaten by Rabbit and Horse was the same (i.e., both ate two carrots), the amount of carrot they ate was different. Importantly, the uneven amount was significant for the two animal characters: the big amount made Rabbit very full, and the small amount was insufficient to relieve Horse’s hunger. Since it is the amount of the carrot substance, rather than the number of individual carrots that plays the decisive role for the quantification judgement, this scenario represents a ‘substance-oriented context’. Against this scenario, the test sentence (18) containing *duo-shao*, which is repeated as sentence (i) in Figure 1, was presented to our participants.

We expected that, in this substance-oriented context, (18) would favorably receive the substance-denoting reading, i.e., ‘Rabbit and Horse ate the **same amount** of carrot’, even though the *duo-shao* sentence is ambiguous as to the individual-denoting reading and the substance-denoting reading, as explained above. This substance-denoting reading makes the sentence appear as a wrong description of the story, and should be rejected by the participants, as Rabbit and Horse ate different sizes of
carrots in the story.

In another typical trial illustrating the individual-oriented context, Black Bird made two big butterflies and Blue Bird made two small butterflies in a magic competition. Both got a reward for their excellent work (Figure 2). In this scenario, the two animal characters made the same number of butterflies (i.e., two butterflies), and the size of the butterflies did not affect the assessment of their work. With this design, the quantity judgment was based on the number of butterflies, rather than their amount or size. In this regard, this scenario represents ‘an individual-oriented context’. Against this backdrop, the test sentence (21), which is the same as sentence (i) in Figure 2, was presented.

(21) *Heiniao zuo le duoshao hudie, Lanniao jiu zuo le*  
Black-Bird make Asp how many/how much butterfly Blue-Bird then make Asp  
*duoshao hudie*  
how many/how much butterfly  
(lit. 1) ‘If Black Bird made X number of butterflies, Blue Bird then made X number of butterflies.’ (Black Bird and Blue Bird made the same number of butterflies)-Favored reading  
(lit. 2) ‘If Black Bird made X amount of butterflies, Blue Bird then made X amount of butterflies.’ (Black Bird and Blue Bird made the same amount of butterflies)—Unfavored reading

Again, even though the *duo-shao* sentence is ambiguous, we expect that in this individual-oriented context, this sentence would favorably receive the individual-denoting reading, i.e., ‘Black Bird and Blue Bird made the same number of butterflies’. In this reading, this sentence would be accepted as a correct description of the story.

There were three similar test items in each condition, and 20 adults were recruited for this session. Overall, there are 60 test items (20 participants * 3 test items) in each condition. The results show that the adults exhibited different responses to the *duo-shao* sentences in the two conditions, just as we expected. In the substance-oriented context, adults rejected the *duo-shao* sentences 80% of the time (48/60 trials). In justifying their rejections of the sentences, they pointed out that the two animals in question acted upon uneven amounts of objects. For instance, in their justification
for the rejection of sentence (18), participants pointed out that Rabbit ate the big carrots, while Horse ate the small carrots. The high percentage of the rejection rate (i.e., 80%) in the substance-oriented context hence indicates that adults quantified over the amount of objects, and assigned the substance-denoting reading to the duo-shao sentences in this context. Conversely, in the individual-oriented context, they accepted the duo-shao sentences 98% of the time (59/60 trials). This suggests that adults quantified over the number of individual objects and assigned the individual-denoting reading to the duo-shao sentences in the individual-oriented context. Taken together, these results show that adults allowed both the individual-denoting reading and the substance-denoting reading in their interpretation of the ‘bare’ duo-shao sentences, and their selection of these two possible readings was clearly adjusted by our contextual manipulation. This confirms our theoretical analysis of this type of wh-pronoun sentences.

The testing of duo-shao-ge sentences and the ji-ge sentences in the other two test sessions also confirms our theoretical analysis. Recall that in our proposal these two types of sentences convey only the individual-denoting reading, due to the presence of the individual classifier ge. This is what we found in the experiment. In our experiment, these two types of sentences were tested in exactly the same substance-oriented context and the individual-oriented context as shown above (See Figure 1 and Figure 2). 40 adults were recruited, with 20 adults in the group for the testing of the duo-shao-ge sentences and 20 adults in the group for the testing of the ji-ge sentences. The results show that the adults accepted the two types of test sentences 100% of the time in the two test conditions. The acceptance of the two types of test sentences indicates that the participants quantified over the number of individual objects in both the substance-oriented context and the individual-oriented context, as the two animals in question acted upon the same number of individual objects in our story situations. For instance, in a typical trial of the substance-oriented context, both Rabbit and Horse ate two carrots. In a typical trial of the individual-oriented context, both Blue Bird and Black Bird made two butterflies. The data hence suggest that Chinese-speaking adults assigned the individual-denoting reading to the duo-shao-ge sentences and the ji-ge sentences in the two distinct contexts, and the interpretation of these two types of sentences is not influenced by our contextual manipulation. This is consistent with our theoretical analysis of these two types of wh-pronoun sentences.
We wish to highlight a comparison between the testing of *duo-shao* sentences and the *duo-shao-ge* sentences in our experiment. As shown earlier, these two types of *wh*-pronouns were tested in the same contexts. In our experiment, native speakers were very sensitive to the presence/absence of the classifier in these two *wh*-pronouns, and assigned different interpretations to them. They assigned the ‘how many’ reading and the ‘how much’ reading to *duo-shao* upon our contextual manipulation, but only the ‘how many’ reading to *duo-shao-ge* no matter how the context was manipulated. Native speakers’ distinct interpretation of *duo-shao* and *duo-shao-ge* and their associated nouns hence clearly indicates that in the adult grammar of Chinese speakers, classifiers shape the countability of *wh*-pronouns and their associated nouns.

To sum up, in this section we have shown that the presence/absence of a classifier determines countability of the *wh*-pronouns *duo-shao*, *duo-shao-ge*, and *ji-ge* and their associated nouns. While the bare *wh*-pronoun *duo-shao* can convey a ‘how many’ reading and a ‘how much’ reading, and its associated noun can exhibit count and mass readings, the classifier-bearing *wh*-pronouns *duo-shao-ge* and *ji-ge* receive only the ‘how many’ reading, and their co-occurring nouns receive only count readings. Our theoretical account is confirmed with data also for the *wh*-pronoun system.

5. Countability in the Quantifier System

The quantifier system is an important grammatical system that also encodes countability. For instance, quantifiers in English are divided into three subcategories: count quantifiers (e.g., *every, several, many, few*), mass quantifiers (e.g., *much, little*), and quantifiers that are underspecified in countability (e.g., *a lot of, more, most, all, some, plenty of*) (Chierchia, 1998). These count and mass quantifiers define the countability of their co-occurring nouns (Borer, 2005). The countability of quantifiers in Chinese is barely studied in the literature. In this section, we propose that the presence/absence of a classifier determines the countability of a quantifier, on a par with the encoding of countability in the nominal system and in the *wh*-pronoun system. This can be illustrated by the interpretive differences between the ‘bare’ quantifier *hen-duo* and the classifier-bearing quantifier *hen-duo-ge*. While the bare quantifier *hen-duo* appears like the English *a lot of* and can function as a count quantifier and a mass quantifier, the classifier-bearing quantifier *hen-duo-ge* functions
as a count quantifier and conveys only the ‘many’ reading. The distinct count-mass status of these two quantifiers shapes the countability of their co-occurring noun. We explain the details below.

Consider the bare quantifier *hen-duo* first. We have just explained that this quantifier can function as a count quantifier and a mass quantifier. When *hen-duo* functions as a count quantifier, its associated noun refers to individual objects. When *hen-duo* functions as a mass quantifier, the associated noun refers to the substance of entities. To illustrate, consider the example (22).

(22) *Women zuotian chi le henduo pingguo.*

- we yesterday eat Asp a lot of apple
- (i) ‘We ate a lot of apples yesterday.’ Individual-denoting reading
- (ii) ‘We ate a lot of apple yesterday.’ Substance-denoting reading

In (22), the phrase *hen-duo ping-guo* can denote a lot of individual apples, which is an individual-denoting reading. In this reading, the phrase does not specify any information on the size or weight of the apples. Hence, it could be possible that these apples are very small, and the overall are not enough to make us full. This count use of *hen-duo ping-guo* can be verified with the use of (23), in which an additional clause is attached to the clause in (22), stating that we are still hungry.

(23) *Women zuotian chi le henduo pingguo, danshi haishi hen e*

we yesterday eat Asp many apple but still very hungry
‘We ate many apples yesterday, but we were still hungry.’

Alternatively, *hen-duo ping-guo* in (22) can denote a large amount of apple substance, which is a substance-denoting reading. In this reading, the noun *ping-guo* does not specify any information about the number or the individual properties of its denotation. So, there could exist only a small number of big apples, or apple chunks, as long as these apples or apple chunks constitute a large enough amount to make us full. This mass use of *hen-duo ping-guo* can be verified with the use of (24), which contains the sentence in (23) and an additional clause stating that we are full.

(24) *Women zuotian chi le henduo pingguo, chi de hen bao*
We ate much apple yesterday, and we were very full.

So far, we have seen that, in the absence of a classifier, the bare quantifier phrase *hen-duo ping-guo* can be construed with the individual-denoting reading (‘many apples’) and the substance-denoting reading (‘much apple’). Thus, Cheng, Doetjes, and Sybesma’s (2008, p. 53) claim that *hen-duo ping-guo* has only the ‘many apples’ reading is incomplete (cf. section 2). Rather, to get the exclusive ‘many apples’ reading, an additional individual classifier such as *ge* has to be added, as shown in (25) below.

(25) Women zuotian chi le *henduoge pingguo*.

We yesterday eat Asp many apple
‘We ate many apples yesterday.’

Individual-denoting reading

Due to the existence of the individual classifier *ge* in (25), substance-denoting readings are not possible for the quantifier phrase *hen-duo-ge ping-guo* in this sentence. This makes the interpretation of (25) (with the quantifier phrase *hen-duo-ge ping-guo*) differ from that of (22) (with the quantifier phrase *hen-duo ping-guo*).

In a similar spirit, we reconsider Cheng, Doetjes, and Sybesma’s (2008, p. 53) claim that the phrase *hen-duo bing-qi-lin* has only a mass use and conveys only the ‘much ice-cream’ reading (cf. Section 2). We think that the phrase *hen-duo bing-qi-lin* in (26) can convey count and mass readings. For instance, it can denote ice-cream cones (an individual-denoting reading) and ice-cream substance (a substance-denoting reading), depending on the specific context in which this phrase appears. This underspecification in countability is resolved when a classifier is added, as illustrated by (27). Thanks to the presence of the individual classifier *ge*, this sentence unambiguously means that ‘we ate many individual ice creams’, and substance-denoting readings are not available here.

(26) Women zuotian chi le *henduo bingqilin*

We yesterday eat Asp many ice cream
(i) ‘We ate many ice cream yesterday.’
(ii) ‘We ate a lot of ice cream yesterday.’

(27) Women zuotian chi le *henduo-ge bingqilin*
We yesterday eat many ice cream
‘We ate many ice creams yesterday.’

In short, sentences (22) and (25) on the one hand, and the sentences (26) and (27) on the other, constitute two minimal pairs, with the presence/absence of a classifier. The presence/absence of a classifier in the quantifier phrases determines the countability of the associated noun. When a classifier is absent, the quantifier phrases are underspecified in countability, and can receive either count or mass readings. The underspecification in countability is resolved when a classifier is involved. This is consistent with our characterization of countability in the nominal classifier system and in the wh-pronoun system as detailed in Sections 3 and 4.

Our analysis of the quantifiers hen-duo and hen-duo-ge is also confirmed with experimental data. In a recent experiment, we tested Chinese-speaking adults’ comprehension of these two quantifiers using the Truth Value Judgement Task (Crain & Thornton, 1998) (cf. footnote (1)). The experimental purpose is to examine whether Chinese speakers would assign the ‘many’ and the ‘much’ readings to the bare quantifier hen-duo in appropriate contexts, and assign only the ‘many’ reading to the classifier-bearing quantifier hen-duo-ge no matter how the context is manipulated. In this experiment, sentences containing hen-duo and sentences containing hen-duo-ge were presented in a substance-oriented context and in an individual-oriented context. The experimental design is summarized with two typical trials as in Figure 3 and Figure 4. More details are explained below.
Figure 3. Substance-oriented context for the *hen-duo/hen-duo-ge* experiment

1. **Substance-oriented context**

Scenario: Baby Giraffe ate a big carrot which was ground to a big pile of carrot substance and he was very full. Baby Monkey ate six tiny carrots which were ground to a small pile of carrot substance and he was still hungry.

Test sentences:

(i) *Changjinglu-baobao chi le hen duo huluobo.*

- *Giraffe-Baby ate Asp many/much carrot.*
- Favored reading: ‘Baby Giraffe ate much carrot.’ **True**
- Unfavored reading: ‘Baby Giraffe ate many carrots.’ **False**

(ii) *Changjinglu-baobao chi le heng duo ge huluobo.*

- *Giraffe-Baby ate Asp many carrot.*
- ‘Baby Giraffe ate many carrots.’ **False**

Figure 4. Individual-oriented context for the *hen-duo/hen-duo-ge* experiment

2. **Individual-oriented context**

Scenario: Minnie and Daisy had a magic competition. Minnie made a big carrot, and Daisy made six tiny carrots. Daisy was rewarded a gold medal, but Minnie got only a dark cross.

Test sentences:

(i) *Mini bian chu le heng duo huluobo.*

- *Minnie make many/much carrot.*
- Favored reading: ‘Minnie made many carrots.’ **False**
- Unfavored reading: ‘Minnie made much carrot.’ **True**

(ii) *Mini bian chu le heng duo ge huluobo.*

- *Minnie make Asp many carrot.*
- ‘Minnie made many carrots.’ **False**
First consider the testing of the bare quantifier *hen-duo*. In a typical trial illustrating the substance-oriented context, Baby Giraffe found a big carrot, and Baby Monkey found six tiny carrots (Figure 3). Baby Giraffe put his big carrot in a food grinder and the grinder produced a big pile of food. He ate the big pile of food and became very full. Baby Monkey also put his six tiny carrots in the food grinder, and the grinder produced a small pile of food. He ate the small pile of food, but was still very hungry. This story represents a substance-oriented context, because the amount of carrots is the most important factor for the quantification judgement: the big amount of the big carrot made Baby Giraffe full and the small amount of the six tiny carrots did not help relieve Baby Monkey’s hunger. Against this scenario, the test sentence (28) containing *hen-duo* was presented to each of our participants.

(28) *Changjinglu-baobao chi le * henduo * huluobo*

(i) Baby Giraffe ate much carrot. (substance-denoting reading)
(ii) Baby Giraffe ate many carrots. (individual-denoting reading)

This substance-oriented context makes salient the substance-denoting reading ‘Baby Giraffe ate much carrot’ for the interpretation of (28), even though this sentence is ambiguous with the individual-denoting reading and the substance-denoting reading, as shown in the gloss. This substance-denoting reading made the sentence appear as a true description of the story, and should be accepted by the participants: in the story, the amount of carrot eaten by Baby Giraffe is much more than that eaten by Baby Monkey.

In another typical trial illustrating the individual-oriented context, Minnie and Daisy had a magic competition (Figure 4). Using magic, Minnie made a big carrot and Daisy made six tiny carrots. The judge Mickey announced that Daisy won the competition, so he gave a gold medal to Daisy and a dark cross to Minnie. In this scenario, the number of carrots plays the decisive role for the quantification judgment: the number of carrots made by Daisy is more than the number of carrots made by Minnie, so Daisy won the medal. In this regard, this scenario set up an individual-oriented context. Against this backdrop, the test sentence (29) was presented.

(29) *Minnie bianchu le * henduo * huluobo*
Minnie make Asp many/much carrot
(i) Minnie made many carrots. (individual-denoting reading)
(ii) Minnie made much carrot. (substance-denoting reading)

Sentence (29) should favor the individual-denoting reading ‘Minnie made many carrots’ in this individual-oriented context, even though this sentence can also convey the substance-denoting reading ‘Minnie made much carrot’. On the individual-denoting reading, this sentence would be rejected as a wrong description of the story: Minnie made only one carrot, which is much fewer than the six carrots made by Daisy.

There were three similar test items in each condition, and 20 adults were recruited for the testing of the *hen-duo* sentences. Overall, there are 60 test items (20 participants * 3 test items) in each condition. The findings show that the adults’ interpretation of the *hen-duo* sentences was adjusted upon our contextual manipulation. In the substance-oriented context, adults accepted the *hen-duo* sentences 88% of the time (53/60 trials). This suggests that the substance-denoting reading was assigned to the *hen-duo* sentences in the substance-oriented context. In the individual-oriented context, adults rejected the sentences 90% of the time (54/60 trials). Their appropriate justification for their rejections of the sentences indicates that the individual-denoting reading was assigned to the *hen-duo* sentences in the individual-oriented context. For instance, when rejecting the sentence (29), they pointed out that Minnie only made one carrot, or that it was Daisy who made many carrots. The exhibition of the ‘many’ reading and the ‘much’ reading in Chinese-speaking adults hence confirms our theoretical analysis of this bare quantifier.

Our characterization of the classifier-bearing quantifier *hen-duo-ge* is also confirmed in our experiment. As explained above, only the ‘many’ reading is available for this quantifier. This is truly what we found in the experiment. Sentences (30) and (31) are two representative *hen-duo-ge* sentences in the substance-oriented context and in the individual-oriented context respectively (see Figure 3 and Figure 4).

(30) *Changjinglu-baobao chi le henduoge huluobo*  
Giraffe- Baby eat Asp many carrot  
‘Baby Giraffe ate many carrots.’
20 adults were recruited to test this type of quantifier. The results indicate that the adults rejected the test sentence 100% of the time both in the substance-oriented context and in the individual-oriented context. They offered the same justification for their rejection of the test sentences in the two conditions. For instance, in their rejection of the sentence (30) in the substance-oriented context, they mentioned that Baby Giraffe only ate one carrot, or it was Baby Monkey who ate many carrots. Similarly, in their rejection of the sentence (31) in the individual-oriented context, they pointed out that Minnie made only one carrot with magic, or it was Daisy who made many carrots. The justifications clearly indicate that the quantification judgment was based on the number of entities, rather than on the amount of entities, and the hen-duo-ge phrase was assigned the individual-denoting reading ‘many’ in both conditions. In other words, this classifier-bearing quantifier unambiguously functions as a count quantifier in the adult grammar, and receives only individual-denoting readings no matter how the context is manipulated. This conforms to our theoretical account, as detailed above.

Let us take stock. In this section, we use hen-duo and hen-duo-ge to illustrate the encoding of countability in the quantifier system. Our theoretical account is confirmed with an experimental study: in Chinese-speaking adults’ comprehension of hen-duo and hen-duo-ge, the presence/absence of a classifier determines the countability of these two quantifiers, and the same nouns receive distinct semantic interpretation in countability when they co-occur with these two quantifiers. As a last note for this section, in addition to the pair of quantifier hen-duo versus hen-duo-ge, many other quantifiers in Chinese, such as hen-shao ‘little/few’ versus hen-shao-ge ‘few’, and geng-duo ‘more’ versus geng-duo-ge ‘more-CLge (a count term)’, exhibit a similar pattern in their encoding of countability. Due to space limitations, we do not get into details here, and instead proceed to the general discussion.

6. General Discussion

We have discussed the encoding of countability in the nominal system, the wh-
pronoun system, and the quantifier system. We have used minimal pairs to examine the countability of linguistic expressions from these three grammatical systems, comparing their countability in the presence/absence of a classifier. In the nominal system, we have compared the countability of bare nouns with that of noun-classifier compounds and classifier-noun structures. In the *wh*-pronoun system, we have compared the countability of the bare *wh*-pronoun *duo-shao* with that of the classifier-bearing *wh*-pronouns *duo-shao-ge* and *ji-ge*. In the quantifier system, we have compared the countability of the bare quantifier *hen-duo* with that of the classifier-bearing quantifier *hen-duo-ge*.

A common pattern is identified in the three grammatical systems: classifiers determine the countability of linguistic expressions. In particular, linguistic expressions containing an individual classifier (e.g., CL<sub>ge</sub>-N structures, *duo-shao-ge*, *hen-duo-ge*) and their associated nouns function as count terms. By contrast, in the absence of a classifier, bare linguistic expressions (e.g., bare nouns, *duo-shao*, and *hen-duo*) and their associated nouns are underspecified in countability, exhibiting count uses and mass uses.

Our account represents a syntactic account on the count-mass in Chinese, which holds that classifiers shape the countability of linguistic expressions (Section 2). Our syntactic account is confirmed via the findings from three sets of experiments, which is summarized in Table 1 below. As their common design feature, all the experiments make use of two sets of variables: the presence/absence of a classifier (bare structures versus classifier-bearing structures) and non-linguistic contexts (individual-oriented contexts versus non-individual/substance-oriented contexts). Therefore, all the three sets of experiments were conducted to examine, in the adult grammar, how the presence/absence of a classifier and non-linguistic contexts interact and affect the countability of linguistic expressions in the nominal system, the *wh*-pronoun system, and the quantifier system.
Table 1. Summary of the three sets of experiments

<table>
<thead>
<tr>
<th>Grammatical systems</th>
<th>The presence/absence of a classifier</th>
<th>Non-linguistic contexts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Individual-oriented context</td>
<td>Non-individual/substance-oriented context</td>
</tr>
<tr>
<td>(1) Nominal system (Huang, 2009; Huang &amp; Lee, 2009)</td>
<td>bare structure</td>
<td>bare noun</td>
</tr>
<tr>
<td></td>
<td>CL-bearing structure</td>
<td>CL-N</td>
</tr>
<tr>
<td>(2) Wh-pronoun system (Huang, Ursini, &amp; Meroni (under review))</td>
<td>bare structure</td>
<td>duo-shao</td>
</tr>
<tr>
<td></td>
<td>CL-bearing structure</td>
<td>duo-shao-ge; ji-ge</td>
</tr>
<tr>
<td>(3) Quantifier system</td>
<td>bare structure</td>
<td>hen-duo</td>
</tr>
<tr>
<td></td>
<td>CL-bearing structure</td>
<td>hen-duo-ge</td>
</tr>
</tbody>
</table>

In particular, in the first set of experiments, sentences containing bare nouns and sentences containing $\text{CL}_\text{ge}$-N structures, were presented in the whole object situations and in the partial object situations (Huang, 2009; Huang & Lee, 2009). In the second set of experiments, sentences containing the bare wh-pronoun $\text{duo-shao}$, sentences containing the classifier-bearing wh-pronoun $\text{duo-shao-ge}$, and sentences containing another classifier-bearing wh-pronoun $\text{ji-ge}$ were presented in the individual-oriented contexts and in the substance-oriented contexts (Huang, Ursini, & Meroni (under review)). In the third set of experiments, sentences containing the bare quantifier $\text{hen-duo}$ and sentences containing the classifier-bearing quantifier $\text{hen-duo-ge}$ were presented in the individual-oriented contexts and in the substance-oriented contexts.

Chinese-speaking adults are found to be sensitive to the presence/absence of the individual classifier $\text{ge}$. Their responses to the classifier-bearing expressions differed from that of the bare linguistic expressions. In particular, they assigned only individual-denoting readings to those classifier-bearing expressions (i.e., $\text{CL}_\text{ge}$-N, $\text{duo-shao-ge}$, $\text{ji-ge}$, $\text{hen-duo-ge}$), but either individual-denoting readings or non-individual-denoting readings (e.g., partial object-denoting reading and substance-denoting...
reading) to those bare linguistic expressions (bare nouns, *duo-shao*, *hen-duo*) in the appropriate contexts (Table 1). The attested sensitivity to the presence/absence of the individual classifier *ge* is consistent to the syntactic view that classifiers determine the countability of a linguistic expression.

Chinese-speaking adults are also found to be sensitive to the non-linguistic contextual information in their interpretation of the bare linguistic expressions. This is particularly important for us to adjudicate the syntactic versus semantic dispute on the count-mass issue in Chinese (cf. Section 2). These two opposing accounts would make distinct predictions about the interpretation of bare linguistic expressions. The semantic account would predict that a certain bare linguistic expression has fixed readings on countability, as countability is taken as part of its inherent lexical properties (e.g., Doetjes, 1997; Cheng & Sybesma, 1998, 1999; Cheng, Doetjes, & Sybesma, 2008). By contrast, the syntactic account would predict that bare linguistic expressions would receive distinct interpretations in countability in distinct contexts, as this account assumes that lexical items themselves do not encode countability, and it is classifiers that encode countability (e.g., Borer, 2005; Huang, 2009; Huang & Lee, 2009).

The prediction of the syntactic account, not the prediction of the semantic account, is borne out in the experiments, as explained below. In the experiments, the adults’ interpretation of bare nouns, the bare *wh*-pronoun *duo-shao*, and the bare quantifier *hen-duo* is flexible, and is adjusted by the contextual manipulation. In particular, adults accepted the sentences containing bare nouns in both the whole-object situations and in the partial object situations (cf. again Huang, 2009; Huang & Lee, 2009). Moreover, in our experiments (Huang, Ursini, & Meroni (under review)), adults assigned the individual-denoting reading to the bare *wh*-pronoun *duo-shao* and the bare quantifier *hen-duo* in the individual-oriented contexts, and assigned the substance-denoting reading to the bare expressions in the substance-oriented contexts. The most convincing evidence is shown in the testing of the bare quantifier *hen-duo*. In that experiment, the same nouns were assigned either the individual-denoting reading or the substance-denoting reading when they occurred with the bare quantifier *hen-duo*, depending on the specific contexts they appeared. For instance, the noun *hu-luo-bo* ‘carrot’ was taken as denoting individual carrots in the individual-oriented context; alternatively, *hu-luo-bo* was taken as denoting carrot substance in the substance-oriented context. These findings conform to the prediction for the syntactic account, and stand against the prediction for the semantic account. Thus,
our experiments successfully use the strategy of contextual manipulation to adjust the interpretation of bare linguistic expressions, offering important empirical data to support the syntactic account.

In addition to the contribution of the study of count-mass in Chinese, our syntactic account of countability bears universal significance for the study of the count-mass issue. Two issues are involved here. First, from a general theoretical perspective, Chinese classifiers constitute a functional category on top of lexical nouns (Cheng & Sybesma, 1999; Borer, 2005; Zhang, 2013), and their function of encoding countability is in parallel with that of other formal means (such as determiners, quantifiers, and plural morphology) in other languages (Cf. Borer, 2005; Piriyawiboon, 2010; Rothstein, 2010; Mathieu, 2012; Cowper & Hall, 2012). This takes our syntactic account of countability in line with the grammatical view of the count-mass issue in general. The grammatical view holds that the concepts of count and mass are built up in constructions larger than lexical nouns (Allan, 1980; Borer, 2005; Pelletier, 2012). The grammatical view represents the most recent trend of the theoretical view on countability. In a volume on the count-mass issue of a wide range of languages, the overall consensus among the contributors is that functional categories play the decisive role in shaping countability of nouns (Wiltschko, 2012; Cowper & Hall, 2012; Pelletier, 2012; Wiese, 2012; Mathieu, 2012; Grimm, 2012). Thus, the present study provides new data to support the grammatical view of the count-mass issue in general.

Secondly, the present study can stimulate new empirical research on the study of nouns in other languages. We have shown that the countability of bare nouns in Chinese is underspecified, and is subject to contextual manipulation in an experimental setting. This experimental strategy can be extended to the study of nouns in other languages. It has long been claimed that countability is not encoded in lexical items, even for languages such as English, which has the grammatical count-mass distinction. For instance, Allan (1980, p. 546) states that ‘countability is not in fact a characteristic of nouns per se’ (see also Sharvy, 1978; Ware, 1979; Pelletier, 1979; Bunt, 1985; Mufwene, 1984). Following this school of thought, we conjecture that the experimental strategy we adopt in the present study can be used to examine whether the countability of nouns in English and other languages are underspecified. However, we will leave this research topic for future research, and move on to the general conclusions.
7. Conclusion

The present study goes beyond the current literature on the count-mass issue in Chinese, which is mainly focused on countability in the nominal system. We have conducted a comprehensive examination of countability across the nominal system, the \(wh\)-pronoun system, and the quantifier system, and characterized a common pattern in the encoding of countability in all of the three grammatical systems: classifiers shape the countability of linguistic expressions. Our theoretical account is confirmed with three sets of experimental data in Chinese-speaking adults. The empirical data give support to the syntactic account of countability, and militate against the semantic account. In a nutshell, the present study combines theoretical analysis with empirical study, and sheds new light on the investigation of the count-mass issue in Chinese, and the count-mass issue in general.

Notes
1 The truth value judgement task involves two experimenters. One experimenter narrates the stories using toys and props. The other experimenter plays the role of a puppet who watches the story alongside the participant. At the end of each story, the puppet is invited to explain to the participant what have happened in the story. The participant’s task is to judge whether the puppet says the right thing or not. If the participant informs the puppet that s/he is wrong, then s/he is asked to explain “what really happened?”. This justification can help confirm the linguistic knowledge of the participant.
2 The participants were tested individually. Each participant was given the test sentences in the two test conditions.
3 Our experimental design borrowed the idea of the thought experiment ‘universal grinder’ from the philosophical study Pelletier (1979). The idea is that one can transform any noun, no matter what ontological properties it has, into mass. In Pelletier’s example, when a man is put into the fictitious machine ‘universal grinder’, and the machine produces human flesh on the floor, one can use the statement ‘there’s man all over the floor’ to describe the scene. See Ware (1979), Allan (1980), Bunt (1985), Zhang (2013) on the flexibility of countability in the use of nouns.

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