The Constituency of Classifier Constructions in Mandarin Chinese
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Abstract
This paper examines the constituency of the construction that contains three elements: a numeral, a word that encodes a counting unit, such as a classifier or measure word, and a noun in Mandarin Chinese. It identifies three structures: a left-branching structure for container measures, standard measures, partitive classifiers, and collective classifiers; a right-branching structure for individual and individuating classifiers; and a structure in which no two of the three elements form a constituent, for kind classifiers. The identification is based on the investigation of four issues: <i>the scope of a left-peripheral modifier; </i><ii>the dependency between the modifier of unit word and that of a noun; </ii><iii>the complement and predicate status of the combination of a numeral and a unit word; </iii><iv>the semantic selection of a unit word on a noun. The paper also falsifies invalid arguments such as the co-occurrence of a numeral and a unit word and the position of certain partitive markers. It also argues against the quantity-individual semantic mappings with the different syntactic structures. Finally, the paper presents a comparative deletion analysis of the constructions in which the functional word *de* follows a unit word.

Key words: classifier, measure, constituent, left-branching, right-branching, Chinese

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1. Introduction
This paper studies one of the most fundamental syntactic issues of classifier and measure word constructions in Mandarin Chinese: their constituency. Such constructions contain three basic elements, i.e., a numeral, such as san ‘three’ in (1), a noun, such as putao ‘grape’ in (1), and a unit word between them, such as the classifier (CL) ke in (1a), the standard measure gongjin ‘kilo’ in (1b), and container measure wan ‘bowl’ in (1c). I call such a construction counting construction.

(1) a. san ke putao  
     three CL grape
   ‘three grapes’

b. san gongjin putao  
     three kilo grape
   ‘three kilos of grapes’

c. san wan putao  
     three bowl grape
   ‘three bowls of grapes’

The occurrence of a unit word is licensed by the occurrence of the other two elements. One basic question is, among the three elements, do any two of them form a constituent? In other words, is the structure of a counting construction left-branching or right-branching?

Greenberg (1990 [1975]: 227) states:

“There are many indications that in the tripartite construction consisting of quantifier (Q) [= numeral], classifier (CI), and head noun (N), Q is in direct construction with CI and this complex construction, which will be called the classifier phrase, is in turn in construction with N.”

Similarly, Li & Thompson (1981: 105), Paris (1981: 105-117), Tang (1990a), Croft (1994: 151), Lin (1997: 419), and Hsieh (2008) all have proposed a unified left-branching structure, in which the numeral and the unit word form a constituent, excluding the noun, as in (2a). In contrast, Tang (1990b: 413, 2005) and Cheng & Sybesma (1998, 1999), among others, have proposed a unified right-branching structure, in which a unit word and the noun form a constituent first, excluding the numeral, as in (2b).

(2)  a.  
    numeral  unit word  NP     b.  
    numeral  unit word  NP
    san     ke        putao     san     ke        putao
    three   CL        grape     three   CL        grape

In contrast to both schools, X. P. Li (2010) proposes that both left- and right-branching structure are possible, and the former is mapped to a quantity or measure reading, whereas the latter is mapped to an individual or counting reading. For instance, liang ping jiu ‘two bottle wine’ has a pure quantity reading in (3a), but an individual reading in (3b). It is claimed that the former has a structure like (2a), and the latter has a structure like (2b).
Although not many arguments have been proposed for any of the above three approaches, I will examine all of the arguments that I can find. In order to investigate whether different types of unit words show different patterns of constituency, I have to check all types of such words. I list the types under my study in (4). In the last column, my terms are compared with those appear in Chao (1968).²

(4)

<table>
<thead>
<tr>
<th>my term</th>
<th>example</th>
<th>description</th>
<th>Chao’s term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard measure</td>
<td>a.</td>
<td>a. shi gongjin luobo</td>
<td>Unit of the dimensions such as length, area, volume, weight</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ten kilo carrot ‘ten kilos of carrots’</td>
<td></td>
</tr>
<tr>
<td>Container measure</td>
<td>b.</td>
<td>b. shi xiang luobo</td>
<td>Unit of capacity dimension, in the form of a container</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ten box carrot ‘ten boxes of carrots’</td>
<td></td>
</tr>
<tr>
<td>Individual CL</td>
<td>c.</td>
<td>c. shi gen luobo</td>
<td>Unit that represents the natural unit of non-mass elements</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ten CL carrot ‘ten carrots’</td>
<td></td>
</tr>
<tr>
<td>Individuating CL</td>
<td>d.</td>
<td>d. shi dui tu</td>
<td>Unit that occurs with a mass noun (e.g. Croft 1994: 162)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ten CL earth ‘ten piles of earth’</td>
<td></td>
</tr>
<tr>
<td>Collective CL</td>
<td>e.</td>
<td>e. shi dui luobo</td>
<td>Unit for counting groups of non-mass elements</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ten CL carrot ‘ten piles of carrots’</td>
<td></td>
</tr>
<tr>
<td>Partitive CL</td>
<td>f.</td>
<td>f. shi pian luobo</td>
<td>Unit for counting parts of a non-mass element</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ten CL carrot ‘ten slices of carrot’</td>
<td></td>
</tr>
<tr>
<td>Kind CL</td>
<td>g.</td>
<td>g. shi zhong luobo</td>
<td>Unit for counting types of elements</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ten CL carrot ‘ten types of carrot’</td>
<td></td>
</tr>
</tbody>
</table>

In this table, the term “non-mass element” means an element that shows natural atomicity. Such an element is encoded by a non-mass noun. The term “mass element” means stuff, which shows no natural atomicity, and is encoded by a mass noun. For an extensive discussion of the defining properties of countability and their realization in Mandarin Chinese, see Zhang (2010b), among others.

² I put aside other types of “measures” in Chao (1968), which are not unit words of nominals.
³ Other than the well-recognized standard measures such as gongjin ‘kilo’, the words nian ‘year’, yue ‘month’, and ri ‘day’ may be ambiguous between unit words and regular nouns (J. Tang 2005: 457). See S. Tang (2010) for a recent research of the issue.
⁴ Partitive CL is a different term from partitive construction (e.g. Fodor & Sag 1982, Jackendoff 1977). The latter denotes a part-whole relation within a definite domain (e.g. three kilos of the tea), whereas pseudo-partitive constructions denote the quantity of entities (e.g. three kilos of tea). The counting constructions discussed here, including those contain a partitive CL, are all pseudo-partitive constructions.
Following Chao (1968), I separate individual CLs from other types of unit words. This type of CLs simply represents the natural unit of non-mass elements, as in (4c). They do not divide or individualize anything. However, individuating CLs, as in (4d), on the other hand, is associated with the idea that “the noun refers to some kind of mass and the classifier gives a unit of this mass” (Denny 1986: 298, cited in Aikhenvald 2003: 318).

Keeping the difference between mass and non-mass nouns in mind, I separate partitive CLs, as in (4f), from individuating CLs, as in (4d), although both are called “partitive measures” in Chao (1968). The former occurs with non-mass nouns, whereas the latter occurs with mass nouns. I also divide kind CLs, as in (4g), from collective CLs, as in (4e), although both are called “group measure” in Chao (1968). The form denotes kind units, and is blind to the distinction between mass and non-mass nouns, whereas the latter does not denote kind units and is for non-mass nouns only.

In my study, the same form of a unit word can belong to different types, depending on the type of the associated noun, and the semantic function of the unit. In (4d), the CL dui occurs with the mass noun tu ‘earth’, and it is thus an individuating CL. However, in (4e), dui occurs with the non-mass noun luobo ‘carrot’, and it is thus a collective CL. Similarly, when the CL pian occurs with luobo ‘carrot’, it denotes a part of a carrot and thus it is a partitive CL, as seen in (4f). But when it occurs with shuye ‘leaf’, as in (5a) below, it represents the natural unit of a leaf, and therefore it is an individual CL. Moreover, if the CL pian occurs with the mass noun moutou ‘wood’, as in (5b), it apportions the mass of wood, therefore it is an individuating CL. The two examples of the CL duo in (6) show the same point.

(5) a. san pian shuye [individual CL] b. san pian mutou [individuating CL]
    three CL leaf  ‘three leafs’
    ‘three pieces of wood’

(6) a. san duo hua [individual CL] b. san duo yun [individuating CL]
    three CL flower ‘three flowers’
    ‘three flowers’
    ‘three pieces of cloud’

In my study, I do not consider words that may not be preceded by any numeral other than yi ‘one’, such as those in (7) (Chao 1968: 603, Li & Thompson 1981: 111). In such constructions, the word yi is probably not a numeral, since it can be replaced by the adjective man ‘full’, whereas other numerals cannot. The element following such use of yi is analyzed as a noun in B. Li (2009).

(7) a. {yi/*san} shen nitu one/three body mud
    ‘a bodyful of mud’
    b. {yi/*san} lian you one/three face oil
    ‘a faceful of oil’

I will make a proposal that the seven types of unit words exhibit three patterns of constituency. The left-branching structure in (2a) is for container measures, standard measures, partitive CLs, and collective CLs; the right-branching structure in (2b) is for individual and individuating CLs; and in the kind CL constructions, no evidence shows that any two of the three elements form a constituent. I will present several arguments to support my proposal.

In addition to this introduction section and the final summary section (Section 6), the organization of the paper is the following. Section 2 presents four arguments for a non-unified analysis of the constituency of counting constructions, and makes the proposal that there are three possible structures. Section 3 discusses three invalid arguments in the constituency study. Section 4 discusses the semantic mappings of the syntactic structures.
Finally, Section 5 discusses the occurrence of the functional word *de* with a counting construction, with respect to the proposed constituency.

2. Four arguments for the non-unified analysis
Unit words do not behave the same syntactically. In this section, I present some differences, and link the differences to different structures of counting constructions.

2.1 The scope of a left-peripheral modifier
Two incompatible modifiers may co-occur if they scope over different constituents. In each of the examples in (8) and (9), two incompatible modifiers co-occur:

(8) a. dada *de* yi wan xiao yingtao
    big *DE* one bowl small cherry
    ‘a big bowl of small cherries’

   b. fangfangzhengzheng *de* yi bao sanjiao binggan
    square *DE* one package triangle cookie
    ‘a square package of triangle cookies’

   c. yuanjuan *de* yi guan fang-tang
    round *DE* one can square-sugar
    ‘a round can of sugar cubes’

   d. hen da *de* yi zhuo xiao keren
    very big *DE* one table small guest
    ‘a very big table of small guests’

(9) a. dada *de* yi dui xiao yingtao
    big *DE* one pile small cherry
    ‘a big pile of small cherries’

   b. hen chang *de* yi pai chao-duan *de* xiao qiche
    very long *DE* one row super-short *DE* small car
    ‘a very long row of super-short small cars’

The acceptability of this type of data indicates that the scope of the left-peripheral modifier excludes the NP, which has its own modifier. This fact shows that the two modification domains belong to two different constituents, and the first constituent is composed by a numeral and a unit word. Putting the categorial labels of the constituent nodes aside, among the three structures in (10) (*Mod = modifier*), only (10a) can capture the fact that the left modifier does not scope over the NP. This left-branching structure is the only possible structure for (8) and (9).

(10) a. b. c.
    Mod   NP   Mod   NP   Mod   numeral
    numeral unit Mod N numeral unit Mod N

In (8), the unit words are all container measures, including the so-called temporary CL *zhuo* ‘table’ in (8d), which can be understood as a contextually-defined container measure. In (9), the unit words are collective CLs. Other types of unit words may not have incompatible modifiers, as seen in (11), for whatever reason. The unit word is the individual CL *li* in (11a),
the individuating CL di in (11b), the partitive CL pian in (11c), the standard measure gongjin ‘kilo’ in (11d), and the kind CL zhong ‘kind’ in (11e).

(11) a. *[dada de] yi li xiao yingtao
    big DE one CL small cherry
    [individual CL]
b. *hen da de yi di xiao shui
    very big DE one CL small water
    [individuating CL]c. *hen da de yi pian xiao {xiangjiao/juzi}
    very big DE one CL small banana/orange
    [partitive CL]d. *hen zhong de yi gongjin qing muliao
    very heavy DE one kilo light wood
    [standard measure]e. *hen da de yi zhong xiao yu
    very big DE one kind small fish
    [kind CL]

Therefore, the left-peripheral modifier test cannot tell the structure of the constructions that have these types of unit words.5

It is necessary to be clarified that the left-peripheral modifier cannot be the result of movement from a position between the numeral and the unit word. This is because the modifier must be followed by de, which means that it must be phrasal (e.g. C. R. Huang 1989, Tang 1990b: 420), however, no unit word may be modified by a phrase in Mandarin Chinese (Tang 1990b: 418). If a phrase moved from a non-phrase position, the movement would violate the Structure-Preserving Constraint (Emonds 1970).

(12) * yi [dada de] wan xiao yingtao
    one big DE bowl small cherry

My conclusion of this subsection is that container measure and collective CL constructions have a left-branching structure, in which the numeral and the unit word form a constituent, excluding the noun.

2.2 Syntactic dependency of modifiers
A shape modifier of a noun can occur as a modifier of an individual CL (Zhu 1982: 52). In (13a), the adjective chang ‘long’ occurs to the left of the CL tiao, and the noun is xianglian ‘necklace’. The exact same adjective may occur to the left of xianglian in (13a’). The two counting constructions mean the same, regardless of the position of the adjective. Other examples in (13) show the same pattern.6

(13) a. yi chang tiao xianglian = a’. yi tiao chang xianglian
    one long CL necklace one CL long necklace
    Both: ‘one long necklace’

5 Note that although the collective CLs allow incompatible modifiers, as shown in (9), the one in (i) does not. In such a CL copying construction, the first CL can be replaced by the individual CL ge, and thus it is not a real collective CL.

(i) a. san qun yang-qun
    three CL sheep-CL
    ‘three groups of sheep’

b. *dada de san qun xiao yang-qun
    big DE three CL small sheep-CL

6 Examples in (13) and other examples in Tang (2005: 446) are counter examples to the claims that individual CLs may not be modified by adjectives (Cheng & Sybesma 1998: 390, 1999: 516) and that if a unit word is modified, the associated noun must denote mass (Cheng 2009: 3).
b. yi bo pian shuye = b’. yi pian bo shuye
one thin CL leaf
Both: ‘one thin leaf’

c. yi hou ben jiaoke-shu = c’. yi ben hou jiaoke-shu
one thick CL text-book
Both: ‘one thick text-book’

d. yi yuan ding maozi = d’. yi ding yuan maozi
one round CL hat
Both: ‘one round hat’

e. yi xiao fang zhang zhuanpian = e’. yi zhang xiao fang zhuanpian
one small square CL photo
Both: ‘one small square photo’

However, such a modifier of a noun cannot occur as a modifier of a container measure or collective CL, as shown in (14).

(14) a. yi chang xiang xianglian ≠ b’. yi xiang chang xianglian [container meas.]
one long box necklace
‘one long box of necklaces’

b. yi da dui maozi ≠ b’. yi dui da maozi [collective CL]
one big CL hat
‘one big pile of hats’

The possible displacement of the modifier in (13) indicates that the unit word c-commands the noun, so that the modifier of the former can be semantically related to the modifier of the latter. The c-command relation can be represented by the right-branching structure. In (14), however, the readings of the left examples are different from those of the right ones. If the structure of such examples is a left-branching one, the unit word does not c-command the noun. This captures the fact that the modifier of the former does not hold a dependency relation with the modifier of the latter.

For other types of unit words, the test does not apply, since no acceptable minimal pair can be found. For instance, a mass noun may not be modified by any shape or dimension adjective (Bunt 1985: 199), and thus (15b) is not acceptable for an independent reason.

(15) a. yi da di shui ≠ b. *yi di da shui [individuating CL]
one big CL water
‘a big drop of water’

My conclusion of this subsection is that individual CL constructions have a right-branching structure and container measure or collective CL constructions have a left-branching structure.

2.3 The complement and predicate status
The combination of a numeral and a standard measure, or a container measure, or a partitive CL, can be the complement or predicate of a dimension-denoting element. In (16a), in the attributive expression introduced by de to the left of the noun gunzi ‘stick’, chang ‘long, length’ takes san cun ‘three inch’ as its complement. Similarly, in (16b), zhong ‘heavy, weight’ takes san laing ‘three liang’ as its complement (1 liang = 50 grams). Other examples in (17) and (18) also illustrate this complement function of the combination of a numeral and a unit word.
In contrast, the combination of a numeral and an individual CL may not have such a function, as seen in (19). In (19a), for example, *chang* ‘long’ takes *san gen kuaizi* ‘three CL chopstick’ as its complement. In the absence the word *kuaizi* ‘chopstick’, the string *san gen* ‘three CL’ alone may not function as a complement (note: in the intended readings of all of the examples in this subsection, the dimension word does not modify the noun to its right).

The contrast is seen not only in attributive expressions, but also in the so-called double subject constructions such as (20) (see Zhang 2009 for the syntax of the construction), and comparative constructions such as (21). In (20a), *liang mi* ‘two meter’ is the predicate of *chang* ‘length’. If we replace the standard measure *mi* ‘meter’ with the individual CL *zhang*, the sentence becomes unacceptable, as seen in (20b). The comparative constructions in (21) show a similar contrast.

Since only a constituent can be a complement, the acceptable examples in (16) through (18), (20a), and (21a) clearly indicate that the combination of the numeral and the unit word is a syntactic constituent. The impossibility for the combination of the numeral and the individual CL to have this function in (19), (20b), and (21b) does not support such a constituency.

Other types of CLs behave like individual CLs in this aspect. The examples in (22) all show that the combination of a numeral and a CL may not be the complement of the dimension word *da* ‘big’.

My conclusion of this subsection is that standard measure, container measure, and partitive CL constructions have a left-branching structure, in which the numeral and the unit
word form a constituent, excluding the noun.

2.4 Semantic selection
A well-known fact is that there may be a semantic selection relation between a CL and the associated noun. Selection means that syntagmatically “certain forms arbitrarily behave alike in one way and certain others behave alike in another.” (Chao 1968: 6; also see Bloomfield 1933: 164-165) A recent discussion of the selection issue of CLs is seen in Wu & Bodomo (2009: 488). In (23a), for instance, the individual CL pi may occur with ma ‘horse’, but not zhu ‘pig’.

(23) a. san pi {ma/*zhu}  
   three CL horse/pig
b. san zhan {deng/*lazhu}  
   three CL lamp/candle
c. san sou {chuan/*feiji}  
   three CL ship/plane

Even the more general individual CLs such as ge and jian (件) have selectional restrictions. Ge may not occur with nouns such as shu ‘book’ (see Loke 1994), and jian may not occur with nouns such as shu ‘book’, deng ‘lamp’, qianbi ‘pencil’, or hua ‘flower’.

Semantic selection is also found in individuating CLs, which occur with mass nouns. In (24a), the individuating CL ji (劑) may occur with yao-shui ‘medicine-liquid’, but not ji-tang ‘chicken-soup’ (contra Chao 1968: 508 “Mass nouns do not have specific classifiers”; also p. 503; Krifka 2008: Sec. 2).

(24) a. yi ji {yao-shui/*ji-tang}  
   one CL medicine-liquid/chicken-soup
b. yi pao {niao/*ji-tang}  
   one CL urine/chicken-soup
c. yi pi {bu/*zhi}  
   one CL cloth/paper

Unlike individual and individuating CLs, other types of unit words do not show selectional restrictions on nouns. In (25a), the container measure chexiang ‘cattle-car’ is blind to the semantic distinction between ma ‘horse’ and zhu ‘pig’. The lack of selectional restriction is also seen in the examples of the standard measure in (26), the collective CLs in (27), the partitive CL in (28), and the kind CL in (29).

(25) a. san chexiang {ma/zhu}  
   three cattle.car horse/pig
   ‘three cattle-cars of horses/pigs’
b. yi wan {yao-shui/ji-tang}  
   one bowl medicine-liquid/chicken-soup
   ‘one bowl of medicine-liquid/chicken-soup’

(26) yi sheng {yao-shui/ji-tang}  
   one liter medicine-liquid/chicken-soup
   ‘one liter of medicine-liquid/chicken-soup’

(27) a. yi dui {shu/shoujuan}  
   one pile book/handkerchief
   ‘one pile of books/handkerchiefs’
b.  yi pian {qiche/mayi}
    one CL  car/ant
    ‘one big area of cars/ants’

(28)  yi pian {xigua/huluobo/juzi}
    one CL  watermelon/carrot/orange
    ‘a slice of watermelon/carrot/orange’

(29)  san zhong {yao-shui/shu}
    three kind  medicine-liquid/book
    ‘three kinds of medicine-liquid/books’

Long & Ma (2008) claim that standard measures never occur with animate nouns. But this constraint simply reflects our world knowledge, since we usually do not measure animate entities with standard measures. So it is a pragmatic constraint, rather than s-selectional restriction. If a proper context is found, the constraint disappears. Imagine if the total weight of certain students is 550 kgs, the following sentence is natural:

(30) Zhuangzai-zhe 550 gongjin xuesheng de na ge qiqiu manman de sheng-qilai le.
    load-PRG     550 kg     student  DE that CL balloon slow   DE rise-up    PRT
    ‘The balloon that has 550 kg students with it is rising up slowly.

Therefore, a semantic selection is found between an individual or individuating CL and its associated noun, but not between a unit word of other types and its associated noun.

Selection relation must be represented in a local syntactic relation, i.e., the two elements that exhibit the relation must form a constituent, excluding other elements. The right-branching structure can capture the semantic relation, since the unit word and the noun form a constituent, whereas the left-branching structure does not capture the relation, since the unit word and the noun do not form a constituent.

In Hsieh (2008:47 fn. 15), a unified left-branching structure is proposed. In order to explain the semantic selection between an individual CL and a noun, a feature-percolating theory is mentioned. However, since the CL in the assumed left-branching structure does not c-command the noun, the assumed percolation is hard to maintain.

Based on the semantic selection of a unit word on its associated noun, I conclude that individual and individuating CL constructions have a right-branching structure, in which the unit word and the noun form a constituent, excluding the numeral. However, no parallel selection is found in other types of unit words, and thus there is no evidence to support this constituency for them.

2.5 Three possible structures
The discussion of this section can be summarized in (31).
The combination of a numeral and a unit word as the scope of a modifier => Left-branching

The complement/predicate status of the combination of a numeral and a unit word => Left-branching

Syntactic dependency of modifiers => Right-branching

Semantic selection of a unit word on a noun => Right-branching

<table>
<thead>
<tr>
<th></th>
<th>The combination of a numeral and a unit word as the scope of a modifier =&gt; Left-branching</th>
<th>The complement/predicate status of the combination of a numeral and a unit word =&gt; Left-branching</th>
<th>Syntactic dependency of modifiers =&gt; Right-branching</th>
<th>Semantic selection of a unit word on a noun =&gt; Right-branching</th>
</tr>
</thead>
<tbody>
<tr>
<td>container measure</td>
<td>+</td>
<td>+</td>
<td>-</td>
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<tr>
<td>standard measure</td>
<td>-</td>
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<td>collective CL</td>
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<td>kind CL</td>
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The blank cells and the cells with a negative value in (31) may indicate that the tests do not apply or the constraints have independent sources. If we consider only the positive values of the four constituency tests, we can conclude that the constructions of the first four classes of unit words (container measures, standard measures, collective CLs, and partitive CLs) have a left-branching structure, in which the numeral and the unit word form a constituent, excluding the noun, as shown in (32a); the constructions of individual and individuating CLs have a right-branching structure, in which the CL and the noun form a constituent, excluding the numeral, as shown in (32b).

(32) a. san ping shui
    three bottle water
    ‘three bottles of water’

b. san di shui
    three CL water
    ‘three drops of water’

The remaining class is kind CLs. The constructions of such CLs do not show evidence for grouping any two of the three elements (the numeral, kind CL, and noun) into a constituent. I speculate that (33b) is the structure of (33a). In this structure, no two overt elements form a constituent, and the noun xigua ‘watermelon’ is merged with an empty element which is co-indexed with the kind CL lei.

(33) a. san lei xigua
     three CL watermelon
     ‘three kinds of watermelons’
We can compare the example in (33a) with the following googled examples, in which a kind CL is followed by a combination of a noun and another kind CL (in the form of lei or zhong):

(34) a. Taiwan te-you [100 zhong niao-lei] jian-jie
    Taiwan special-have 100 kind bird-kind concise-introduction
    ‘a concise introduction to 100 kinds of birds that exist only in Taiwan’

b. renhe liang zhong zhiwu-lei
    any two kind plant-kind
    ‘any two kinds of plants’

c. Bei Taiwan de ren ke fen-wei liang lei ren-zhong.
    north Taiwan DE person can divide-into two kind person-kind
    ‘The people in the Northern Taiwan can be divided into two types.’

In each example of (34), there is an overt kind CL to the right of the noun. So the silent e in (33b) can have an overt counterpart in other examples. What is important to my discussion here is that in (33a), the overt kind CL lei does not form a constituent with the noun xigua ‘water-melon’. In the absence of evidence for an alternative analysis, to capture the properties of kind CLs, (33b) can be a plausible hypothesis.7

3. Three invalid arguments
In this section, I falsify three arguments that have been used in the literature to support syntactic constituency of counting constructions: the co-occurrence of a numeral and a unit word, the position of certain partitive markers, and the immobility of a numeral-CL string.

3.1 The co-occurrence of a numeral and a unit word
In CL languages such as Chinese, a numeral and a CL are adjacent. Greenberg (1972) thus claim that the two elements should form a constituent. Similarly, Croft (1994: 151) claims that since a CL and a numeral co-occur, they must form a constituent. Thus a unified left-branching structure for all CL constructions is proposed from this co-occurrence perspective.

This is not an effective argument (contra Wilhelm 2008: 60). In English, an auxiliary (e.g. have and be) needs to occur with a subject or expletive, but they never form a constituent. Also, as pointed out by Krifka (2008: Sec. 6.3), the co-occurrence of two elements might lead to certain morphological combination, which does not mean that the two elements form a syntactic constituent. The situation can be similar to the fusion of a preposition and its following article in French aux (= à les ‘to the’) and German beim (= bei

7 Liao (2008) claims that in a partitive construction, the lower CL must be a kind CL, as in (ia). However, in (ib), the lower CL is an individual CL. Data like (ib) are counter-examples to the claim.

(i) a. san zhi zhe yi zhong gou
    three CL this one kind dog
    ‘three of this kind of dogs’

b. san pian zhe i ge xigua
    three CL this one CL watermelon
    ‘three slices of this watermelon’
dem ‘at the’).

In many cases, the co-occurrence is a semantic requirement, which does not have to match syntactic constituency. In counting, a numeral needs to occur with an overt or covert counting unit, and a unit word encodes such a unit (Wilhelm 2008). Therefore, a numeral generally occurs with a unit word, either a CL or a measure word in Mandarin Chinese. A numeral and a CL may also form a phonological phrase. However, as is well-known, phonological phrases are not necessarily isomorphic to syntactic constituents. For instance, the syntactic constituency of (35a) is not reflected in the phonological grouping in (35b) (Jackendoff 1997: 26).

(35)  a. [DP a [NP [AP big] house]]  b. [ψ [ω a big] [ψ house]]

3.2 The position of two partitive markers

3.2.1 The position of duo ‘more’

Lü et al. (1999 [1980]) claim that duo ‘more’ may follow a measure word, but not a CL in general (with exceptions; see 3.2.3 below). Wang (1994) uses the occurrence of the post-unit duo to distinguish CLs from measure words. It seems that if duo follows a unit word, the two elements to its left, i.e., a numeral and a unit word, might form a constituent. This is an argument for a general left-branching structure in Hsieh (2008: 46). X. P. Li (2010: 120) uses the same argument to claim that such duo constructions have a left-branching structure.

However, the position of duo is not an effective argument in judging the constituency of the containing structure, for the following reason.

Duo is an additive partitive quantifier, scoping over the single unit-morpheme to its immediate left. The unit morpheme can be a numeral unit, such as shi ‘ten’, bai ‘hundred’, qian ‘thousand’, etc., or a measure word, or a CL. In (36), for instance, the unit morpheme to the immediate left of duo is shi ‘ten’, which is the second morpheme of the word wu-shi ‘five-ten => 50’. The quantity expressed by this example is 50 plus a part of shi ‘ten’. It can be any number between 50 and 60.

(36)  wu-shi duo feng xin
      five-ten more CL letter
      ‘fifty and more letters’ (50 < x < 60)

Importantly, duo does not scope over the two-morpheme string wu-shi ‘fifty’ in (36), since the reading of the phrase may not cover figures such as 70, which is 50 plus 20 (20 is a part of 50). The following minimal pair is telling (from Lü et al. 1999 [1980]: 184; 1 mu = 6.666 m²). Both (37a) and (37b) can be roughly translated as ‘10 mus and more land’. But precisely speaking, they cover different ranges.

(37) a. shi duo mu di
      ten more mu land
      ‘10 mus and more land’ (10 < x < 20)

b. shi mu duo di
      ten mu more land
      ‘10 mus and more land’ (10 < x < 11)

In (37a), duo ‘more’ is adjacent to shi ‘ten’ to its left. It means part of shi then. The quantity expressed by the whole phrase is 10 plus a part of 10, i.e., any figure between 10 and 20 (e.g. 12 mu). In (37b), duo is adjacent to the standard measure mu to its left. It means part of one mu then. The quantity expressed by the whole phrase is 10 plus a part of one mu, i.e., any figure between 10 and 11 mu (e.g. 10.6 mu).

Similarly, the reading of (38a) is 30 plus a part of 10. The quantity expressed by the whole nominal is thus any number between 30 and 40, e.g. 33 mu. In contrast, the reading of
(38b) is 30 plus a part of one \textit{mu}. The quantity expressed by the whole nominal is any number between 30 and 31 \textit{mu}, e.g. 30.4 \textit{mu}.

(38) a. san-shi duo mu di b. san-shi mu duo di
three-ten more \textit{mu} land three-ten \textit{mu} more land
‘30 \textit{mus} and more land’ (30 < x < 40) ‘30 \textit{mus} and more land’ (30 < x < 31)

Therefore, if \textit{duo} follows a unit word, as in (37b) and (38b), it scopes over the unit only, excluding the numeral. Thus, there is nothing indicating the numeral and the unit word form a syntactic constituent.

\textbf{3.2.2 The position of \textit{ban} ‘half’}

Lü et al. (1999 [1080]) claim that \textit{ban} ‘half’ may follow a measure word, but not a CL in general (with exceptions; see 3.2.3 below). The post-unit word position of \textit{ban} seems to suggest that the numeral and the unit word form a constituent, which is separated from the noun by \textit{ban}. Hsieh (2008:46) uses the post-unit position of \textit{ban} to argue for a general left-branching structure. Again, I think the argument is not valid.

Like \textit{duo} ‘more’, \textit{ban} ‘half’ is also a partitive quantifier, scoping over one single adjacent morpheme. When \textit{ban} follows a unit, it scopes over the unit only, excluding the numeral. For instance, in the three examples in (39), \textit{ban} follows \textit{mi} ‘meter’. The reading of (39a) is 5 plus a half of a meter, i.e., 5.5 m. The reading of (39b) is 13 plus a half of a meter, i.e., 13.5 m. It never means the half of 13 (i.e., 6.5). Similarly, the reading of (39c) is 300 plus a half of a meter, i.e., 300.5m.\footnote{The partitive markers \textit{ban} ‘half,’ \textit{ji} ‘a few, several,’ and \textit{duo} ‘more’ have different distributions. Although \textit{duo} can either precede or follow a unit word, as seen in (37) and (38), \textit{ban} may not precede a unit word, and \textit{ji} may not follow a unit word:

(i) a. shi mi ban b. *shi ban mi (ii) a. *shi mi ji b. shi ji mi
ten meter half ten half meter ten meter several ten several meter
’10.5 meters’ ‘10 and more meters’}

(39) a. wu mi ban b. shi-san mi ban c. san-bai mi ban
five meter half ten-three meter half three-hundred meter half
‘5.5 meters’ ‘13.5 meters’ ‘300.5 meters’

Since \textit{ban} never scopes over the combination of a numeral and a unit word, it does not show whether the combination is a constituent or not.

\textbf{3.2.3 The real condition for the occurrence of post-unit \textit{duo} and \textit{ban}}

When Lü et al. (1999 [1080]) claim that \textit{duo} ‘more’ and \textit{ban} ‘half’ may not follow a CL, they also report some exceptions. We have shown that when these two partitive markers follow a unit word, they scope over the unit word only, introducing an additional fractional quantity. My own observation is that if a context allows the occurrence of a fractional numeral, it also allows the occurrence of \textit{duo} or \textit{ban} after a unit word, including a CL. In (40a), the verb \textit{yong} ‘use’ takes the object that has the fractional numeral 3/4. In (40b) and (40c), we see that in the same context, the object can contain the partitive marker \textit{duo} and \textit{ban}, respectively. In (41a), however, the verb \textit{zhaixia} ‘pick’ may not take the object that has the fractional numeral 3/4. Then in (41b) and (41c), we see that in the same context, the object may not contain the partitive marker \textit{duo} and \textit{ban}, respectively. The examples in (42) and (43) show the same contrast.
(40) a. Zuo zhe ge dangao wo yong-le 3/4 ge pingguo.  
make this CL cake I use-PRF 3/4 CL apple  
‘I used three fourth of an apple to make this cake.’  
b. Zuo zhe ge dangao wo yong-le yi ge duo pingguo.  
make this CL cake I use-PRF one CL more apple  
‘I used an apple and more to make this cake.’  
c. Zuo zhe ge dangao wo yong-le yi ge ban pingguo.  
make this CL cake I use-PRF one CL half apple  
‘I used one and a half apple to make this cake.’

he from tree-on pick-PRF 3/4 CL apple  
b. *Ta cong shu-shang zhaixia-le yi ge duo pingguo.  
he from tree-on pick-PRF one CL more apple  
c. *Ta cong shu-shang zhaixia-le yi ge ban pingguo.  
he from tree-on pick-PRF one CL half apple

that CL sheep chew-broken-PRF 3/4 CL pencil  
‘That sheep chewed three fourth of a pencil into pieces.’  
b. Na zhi yang yao-sui-le san zhi duo qianbi.  
that CL sheep chew-broken-PRF three CL more pencil  
‘That sheep chewed three and more pencils into pieces.’  
c. Na zhi yang yao-sui-le san zhi ban qianbi.  
that CL sheep chew-broken-PRF three CL half pencil  
‘That sheep chewed three and a half pencils into pieces.’

I buy-PRF 3/4 CL pencil  
b. *Wo mai-le san zhi duo qianbi.  
I buy-PRF three CL more pencil  
c. *Wo mai-le san zhi ban qianbi.  
I buy-PRF three CL half pencil

The same numeral-initial nominal may occur in one context, but not another. The acceptability contrast exhibited in the above data is not a contrast in nominal-internal constituency. Just like existential verbs may not take a definite argument, certain verbs may be sensitive to other formal properties of nominal arguments. Thus, it is possible that verbs like those in (41) and (43) disallow their numeral-initial argument to have a fractional number. Instead, only integers are allowed.

3.3 The movement argument
In Chinese, the combination of a numeral and a unit word may not be fronted:

(44) a. Shufen mai-le san ben shu.  
Shufen buy-PRF three CL book  
‘Shufen bought three books.’  
b. *San ben, Shufen mai-le shu.  
three CL Shufen buy-PRF book

(45) a. Shufen mai-le san jin niurou.  
Shufen buy-PRF three jin beef  
‘Shufen bought three jins of beef.’  
b. *San jin, Shufen mai-le niurou.  
three jin Shufen buy-PRF beef

This is in contrast to the following Japanese examples:
Saito et al. (2008: 260) use the contrast between (44) and (46) to show that the CL construction is right-branching in Chinese and thus the combination of the numeral and the CL may not move, whereas the CL construction is left-branching in Japanese and thus the combination of the numeral and the CL can move (see Watanabe 2010 for more discussion of the syntax of Japanese CL constructions). In this paper, I have also argued that individual CL constructions in Chinese have a right-branching structure, and thus the unacceptability of (44b) is expected. Our conclusion is compatible with Saito et al.’s. However, if the constructions of some other types of unit words, such as the standard measure in (45a), have a left-branching structure, as we proposed, why may the combination of the numeral and the unit word still not move, as seen in (45b)?

I think the unacceptability of (45b) does not falsify my analysis. The reason is that the parallel left quantity-denoting constituent of a nominal may not move in Chinese, either, as seen in (47b). The constituency status of the string *hen duo ‘very many’ is not controversial. The fact that the string may not move does not affect its constituent status.

4. Remarks on the semantic mappings of the different structures
Non-unified structures of CL constructions have also been argued for in the literature. However, different structures are claimed to correlate with different readings. In this section, I argue against two such mappings.

4.1 Against the individual-quantity mapping
X. P. Li (2010: 118-121) claims that for a numeral-initial nominal in Mandarin Chinese, a quantity or measure reading is mapped to the left-branching structure, whereas an individual or counting reading is mapped to the right-branching structure. Four arguments are presented to support this individual-quantity mapping: (A) the silence of a numeral; (B) the position of *de; (C) the position of duo; and (D) the position of a relative clause. Argument C has been shown to be invalid in my 3.2.2 above. The problems of Argument B will be discussed in Section 5. In this section, I falsify Arguments A and D, i.e., the silent numeral argument and the relative clause argument.

The silent numeral argument for the individual-quantity mapping of constituency is based on the following fact. The numeral yi ‘one’ to the left of a unit word may be silent (D. Yang 1996; Cheng & Sybesma 1999: 530, among others). D. Yang (1996; also see R. Yang 2001: 86) specifies that the silence may occur when yi immediately follows a verb, a
demonstrative, or a universal quantifier. The three examples in (48) all allow a silent yi.

(48) a. Shufen mai-le (yi) ben shu.
   Shufen buy-PRF one CL book
   ‘Shufen bought a book.’

b. zhe (yi) ben shu
   this one CL book
   ‘this book’

c. mei (yi) ben shu
   every one CL book
   ‘every book’

It has been shown in D. Yang (1996; also see Hsieh 2008: 125) that on a quantity reading, the unit word must co-occur with an overt numeral, whereas on an individual reading, the numeral yi ‘one’ can be silent. I use (49) to show the contrast:

(49) a. Shufen mai-le _ gang xiancai.
   Shufen buy-PRF jar pickle
   ‘Shufen bought a jar of pickles.’

   Shufen not-more-not-less exactly buy-PRF one jar pickle
   ‘Shufen bought exactly one jar of pickles, no more and no less.’

In (49a), the numeral to the left of the container measure word gang is silent. Such a construction has an exclusive indefinite individual reading, rather than quantity reading (e.g. Hsieh 2008: 125). This can be seen in (49b), where the expressions bu-duo-bu-shao ‘not-more-not-less’ and zhenghao ‘exactly’ signal a quantity reading. In this context, it is impossible to delete the numeral yi ‘one’.

X. P. Li claims that since a numeral may not be silent in a quantity reading, the dependence of a unit word on a numeral in the quantity reading is closer than the one in the individual reading. He claims that for this reason, in the quantity reading, but not in the individual reading, a numeral and a unit word should form a constituent, a left-branching structure. Thus, the same numeral-initial expression may have two different structures. (49a) has a right-branching structure, whereas (49b) has a left-branching structure.

More plausibly, I think, the numeral may not be deleted for a quantity reading simply because the numeral is the focus of such a reading. This follows the general principle of PF deletion: it never applies to focused element.

We further observe that all types of unit words can occur with a silent yi ‘one’, as shown in (50), including a standard measure, seen in (50d). In all of these examples in (50), the implicit yi is not focused, and thus only the individual reading is available.

(50) a. Wo xiang mai ben shu.       [individual CL]
   I want buy CL book
   ‘I want to buy a book.’

b. wo gang chi-le pian niu-rou.     [individuating CL]
   I just eat-PRF slice cow-meat
   ‘I just ate a slice of beef.’

c. Wo xiang mai ping jiu.       [container measure]
   I want buy bottle wine
   ‘I want to buy a bottle of wine.’
In Section 2 I have argued that individual and individuating CL constructions have a right-branching structure, and container measure, standard measure, partitive CL and collective CL constructions have a left-branching structure. The fact that all types of counting constructions allow the silent yi and thus may have both individual and quantity readings indicates that the syntactic distinction does not correlate with the semantic distinction of the two readings.

Note that the absence of yi ‘one’ is phonological, since the reading of all of the above examples must be singular. li is semantically and syntactically present. Therefore, The silence of yi does not tell us the constituency of the relevant structure.

It needs to be pointed out that like the constructions with an overt yi, constructions with a covert yi can also be specific. Data like the following show that Cheng & Sybesma’s (1999: 526) claim that silent yi constructions must be non-specific is not accurate. The post-BA position is a typical position for definite or specific indefinite nominals. Since a counting expression with a silent yi may occur in this position, as seen in (51a), it can be specific. Similarly, the subject of a secondary predicate in an existential coda construction (J. Huang 1987) must be specific indefinite. Since a counting expression with a silent yi may also occur in this position, as seen in (51b), it can be specific.

\[(51)\]
\[
\text{a. Shouwei ba ge cong nanfang lai de xiaotou fang-pao-le.} \\
\text{guard BA CL from south come DE thief release-away-PRF} \\
\text{‘The guard got released a thief who had come from the south.’}
\]
\[
\text{b. Shufen mai-le zhang zhuozi san tiao tui.} \\
\text{Shufen buy-PRF CL table three CL leg} \\
\text{‘Shufen bought a table which has three legs.’}
\]

The relative clause argument for the individual-quantity mapping of constituency is based on the fact that in Chinese, a relative clause may either immediately precede a noun, as in (52a), or precede a numeral, as in (52b).

\[(52)\]

\[
\text{a. ta he-le yi wan [RC mama zuo de] tang.} \\
\text{he drink-PRF one bowl mom make DE soup} \\
\text{‘He drank one bowl of soup that mom made.’}
\]

The nominal that has a pre-numeral modifier, such as the one in (52b), is exclusively specific (Zhang 2006), and thus must have an individual reading, rather than a quantity
reading. X. P. Li (2010: 120) labels an individual reading as a counting reading and a quantity reading as a measure reading. In his analysis, it is assumed that the object in (52a) has a left-branching structure [[yi wan] tang], and the object in (52b) has a right-branching structure [yi [wan tang]]. However, it is more likely that the higher relative clause in (52a) is hosted by a higher functional projection of the whole complex nominal, and the lower relative clause in (52b) is hosted by a projection local to the noun. Therefore, the different positions of the relative clause have nothing to do with the constituency of the numeral, the unit word, and the noun of the construction.

In (52), the unit word is a container measure. Constructions of other types of unit words also allow pre-numeral relative clause. In (53), for instance, the unit word is the individual CL ben. We can see that the pre-numeral relative clause is available regardless of the type of the unit word to the right of the numeral.

(53) a.  ta kan-le yi ben [RC baba xie de] shu.
   he read-PRF one CL dad write DE book
b.  ta kan-le [RC baba xie de] yi ben shu.
   he read-PRF dad write DE one CL book
   BOTH: ‘He read one book that dad wrote.’

We conclude that the arguments for the individual-quantity mapping of constituency are all problematic.

The syntactic contrast between a quantity-reading and individual reading of a nominal has been seriously studied since A. Li (1998). A. Li presents certain tests to tear the two readings apart in Mandarin Chinese. For instance, the quantity reading of san ge ren ‘three CL person’ in (54a) may not enter into a co-referential relation with a following pronoun, but the individual-reading of the same nominal in (54b) may do so (A. Li 1998: 698).

   three CL people lift-not-move this CL piano    their  DE strength too small
   ‘Three people cannot lift up this piano. Their strength is too weak.’
b.  Ta mingtian hui kandao san ge ren, hai hui gen tamen zuo pengyou.
   he tomorrow will see    three CL people and will with them make friends
   ‘He will meet three people tomorrow and will make friends with them.’

Rothstein (2009) also presents a few contrastive properties of the two readings. They are compatible with A. Li’s observation. She (p. 110) also mentions that in English, “On the measure reading, the suffix -ful(s) can often be added to the classifier, but this is inappropriate for the individuating reading.” The examples in (55) are given to show the contrast:

(55) a.  Add two cup(ful)s of wine to the soup.         [quantity]
b.  Bring two cup(#ful)s of wine for our guests.      [individual]
c.  We needed three bucket(ful)s of cement to build that wall.   [quantity]
d.  Three bucket(#ful)s of mud were standing in a row against the wall. [individual]

According to Akmajian & Lehrer (1976: 412), “The suffix –ful added to nouns is a partially productive way of converting nouns to quantifiers.” If a speaker chooses the quantifier version of an expression (i.e., the –ful form), instead of the plain noun version, the intended meaning must be a quantity (or measure) one, instead of an individual one.

Rothstein further reports certain morphological contrasts of the two readings in Hebrew.
However, no constituency contrast is presented.

In A. Li (1998), the contrast of the two readings is represented as the contrast between NumP (for the quantity reading) and DP (for the individual reading). The latter has one more layer of functional projection than the former. Liao (2010) argues that the contrast should be represented at a higher level, such as a projection of modals. In neither A. Li’s work nor Liao’s work have we seen any claim to support a contrast in the nominal-internal constituency.

The different types of constituency argued in my Section 2 do not correlate with the individual-quantity contrast. Every structure may have both readings. In (56), the individual CL duo and the noun hua ‘flower’ form a constituent, excluding the numeral san ‘three’ (i.e., right-branching structure). Now we see that (56a) has an individual reading and (56b) has a quantity reading. In (57), the container measure ping ‘bottle’ and the numeral san ‘three’ form a constituent, excluding the noun jiu ‘wine’ (i.e., left-branching structure). (57a) has an individual reading and (57b) has a quantity reading. In (58), the kind CL zhong ‘kind’ does not form a constituent with either the numeral san ‘three’ or the noun yu ‘fish’. (58a) has an individual reading and (58b) has a quantity reading.

(56) a.  wo ba san duo hua dou fang zai zhuozi-shang le.  [individual]
     I  BA three CL flower all  put at table-on  PRT
     ‘I put all of the three flowers on the table.’

     b.  zheli zhi neng fang san duo hua.  [quantity]
     here only can put three CL flower
     ‘Only three flowers can be put here.’

(57) a. wo ba san ping jiu dou fang zai zhuozi-shang le.  [individual]
     I  BA three bottle wine all  put at table-on  PRT
     ‘I put all of the three bottles of wine on the table.’

     b.  zhexie qian zhi neng mai san ping jiu.  [quantity]
     this money only can buy three bottle wine
     ‘This amount of money can buy only three bottles of wine.’

(58) a. You san zhong yu de hen kuai.  [individual]
     have three kind fish swim DE very fast
     ‘There are three kinds of fish which swim very fast.’

     b.  Ni zuiduo zhi neng tiao san zhong yu.  [quantity]
     you most only can choose three kind fish
     ‘You can choose only three kinds of fish at most.’

In X. P. Li (2010), individual CL constructions have a default individual reading (p. 123), as in my (56a), and such a reading has a right-branching structure. For the possible quantity reading of such constructions, as in my (56b), he resorts to the operation of semantic shift (p. 135). Since quantity reading has a left-branching structure in his analysis, the assumed semantic shift must correlate with a change in the syntactic structure. However, no syntactic evidence has been shown to support a left-branching structure for individual CL constructions.

Moreover, consider the two modification examples in (8) and (9). As mentioned above, if a construction has a pre-numeral modifier, it has an individual reading, but the modification evidence shows that in such examples, the construction clearly has a left-branching structure. This is unexpected if individual readings correlate with a right-branching structure.

Furthermore, English numeral-initial count NPs such as three small children have no CL, but they also have the two readings (Li 1998: 695). The numeral-initial nominalis in (59a) and (59b) both have a quantity reading, whereas the one in (60) has an individual reading. There
is no evidence for the difference in the c-commanding relation of *three* and *small children* between (59a) and (60).

(59) a. That bed sleeps three small children.
   b. That hotel suite accommodated 100 guests.
(60) Three small children have arrived. They are all in the kitchen.

I thus claim that the contrast between a left- and right-branching structure of unit constructions does not correlate with the contrast between individual and quantity readings.

### 4.2 Against the container-containee mapping

Since Selkirk (1977), it has been noted that a container measure expression can have either a container reading or a containee reading. The two readings can be shown in my Chinese examples in (61a) and (61b), respectively.

(61) a. Shufen dasui-le san ping niunai. b. Shufen he-le san ping niunai.
   Shufen break-PRF three bottle milk    Shufen drink-PRF three bottle milk
   ‘Shufen broke three bottles of milk.’    ‘Shufen drank three bottles of milk.’

Selkirk (1977) claims that the containee reading is also a quantity reading, and it has a left-branching structure, whereas the container reading has a right-branching structure. A similar proposal is made in Landman (2004, cited in Rothstein 2009). Zhang (2010a) argues against this constituency analysis and proposes that the contrast between the container and containee reading is a matter of the projection of semantic features, from the same syntactic structure.

X. P. Li (2010), following Rothstein (2009), correlates the container reading with an individual reading, which is assumed to have a right-branching structure, and correlates the containee reading with a quantity reading, which is assumed to have a left-branching structure. However, our following examples show that the two correlations are not justified. In the two examples in (62), *shi ping jiu* ‘ten bottle wine’ has a containee reading. In (62a), the word *zuzu* ‘as much as’ provides a quantity context, and thus a quantity reading is available. In Li’s approach, the expression has a left-branching structure. However, in (62b), the reduplicate form of *ping-ping* ‘bottle-bottle’ provides an individual context (X. P. Li 2010: 115), and thus *shi ping jiu* should have an individual reading. Likewise, the container reading of *shi ping jiu* in (63) can have either a quantity reading, as in (63a), or individual reading, as in (63b).

(62) a. Siyu zuzu he-le shi ping jiu. [Containee, quantity]
   Siyu as.much.as drink-PRF ten bottle wine
   ‘Siyu drank as much as ten bottles of wine.’
   b. Siyu he-le shi ping jiu, ping-ping dou hen haohe. [Containee, individual]
   Siyu drink-PRF ten bottle wine bottle-bottle all very good
   ‘Siyu drank ten bottles of wine, and every bottle was very excellent.’

(63) a. Siyu lin-lai-le zuzu shi ping jiu. [Container, quantity]
   Siyu bring-come-PRF as.much.as ten bottle wine
   ‘Siyu brought as many as ten bottles of wine.’
   b. Siyu dasui-le shi ping jiu, ping-ping dou hen zhengui. [Container, individual]
   Siyu break-PRF ten bottle wine bottle-bottle all very precious
   ‘Siyu broke ten bottles of wine, and every bottle was very precious.’
All of these simply show that the following three contrasts are independent each other: container vs. containee reading, quantity vs. individual reading, and the left-branching vs. right-branching structure.

4.3 More remarks
In addition to the two syntax-semantics mappings that I argued against in the previous two subsections, some other mappings are also seen in the literature. For instance, Tang (1990a: 353) mentions that in English, mass noun constructions have a left-branching structure and count noun constructions have a right-branching structure. The same correlation is also stated in Watanabe (2006: 261, 270) for Japanese. It is beyond the scope of this paper to discuss these languages. In my own analysis of Mandarin Chinese, the contrast between a left-branching structure and right-branching structure is obviously not that between count and mass nouns. My conclusion that individual and individuating CL constructions have the identical constituency shows that there is no structure difference between mass nouns and non-mass nouns in Chinese.

I have argued against certain mappings between syntactic structures of counting constructions and their semantic interpretations. The remaining issue is whether there is any plausible mapping at all, in Mandarin Chinese, at least. The different patterns of constituency divide the seven types of unit words into three groups. I leave to semanticians to find out the shared semantic property for each group, if there is any.

5. The constituency and the occurrence of de
5.1 Background
In Mandarin Chinese, the functional element de may introduce a modifier such as an adjective or relative clause to the left of another element. We have seen such examples in (8) and (9). De may also surface between a unit word and a noun. If the unit word is an individual or individuating CL, there are certain constrains, which will be explained later. However, in general, all types of unit words may be followed by de, as observed in Tang (2005: 444), Hsieh (2008: 42), X. P. Li (2010), and Her & Hsieh (2010: 540).9 10

(64) a. Shufen chi-le yi-bai {ge/gongjin/bao/pian/dui/zhong} de pingguo.
   Shufen eat-PRF one-hundred CL/kilo/bag/slice/pile/kind DE apple
   ‘Shufen ate 100 apples or 100 {kilos/bags/slices/piles/kinds} of apples.’
   b. Shufen chi-le san-fen-zhi-yi li de ganmao-yao. (X. P. Li 2010: 203)
   Shufen eat-PRF one-third CL DE cold-pill
   ‘Shufen took one third of a cold pill.’
   c. Yi liang tiao de maojin ni zong mai-de-qi ba!
   one two CL DE towel you after all buy-can PRT
   ‘You should be able to afford to buy one or two towels!’

Hsieh (2008: 45) claims that “The use of de calls for the organization of all the relevant

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9 I do not consider the inherent attributive use of numeral expressions, as shown by the underlined part in (i) (Tang 2005: 434).

(i) a. Ta mai-le liang tao [wu ben de shu]. b. Ta mai-le liang mi [yi gongfen de shengzi].
   he buy-PRF two CL five CL DE book he buy-PRF two meter one cm DE rope
   ‘He bought 2 sets of 5 volume books.’ ‘He bought two meters of the rope that is 1 cm thick.’

Such attributive constructions have different syntactic and semantic properties from the pseudo-partitive constructions discussed here. See Schwatzchild (2006), Hsieh (2008), Liao (2008), and X. P. Li (2010) for discussions of such constructions.

10 Examples in (64) and other examples in Tang (2005: 444) and Hsieh (2008: 42) are counter examples to the claim that individual CLs may not be followed by de (Cheng & Sybesma 1998, 1999).
information in an N-C sequence as a constituent.” (her N = numeral; C = CL) The same idea is found in X. P. Li (2010: 205, his Argument B, as I mentioned at the beginning of my 4.1). Thus a unified left-branching structure is argued for from this de-perspective.

However, we have shown that an individual CL construction may not have two incompatible modifiers (see 2.1). If de occurs, the constraint remains. The consistency does not support a left-branching structure for the counting construction.

(65) *Shufen chi-le  hen da de yi-bai ge (de) xiao  pingguo.
    Shufen eat-PRF very big DE 100 CL  DE small apple

Moreover, if an individual or individuating CL s-selects a noun, it does so regardless of the presence of de. In (66), the noun pingguo ‘apple’ may occur with the CL ge, but not the CL zhan. The latter is for lamps. The selection restriction is not affected by the occurrence of de. I have argued that the selection supports a right-branching structure, rather than a left-branching one. This consistency again does not support a left-branching structure for the counting construction.

(66) Shufen chi-le  yi-bai {ge/*zhan} (de) pingguo.
    Shufen eat-PRF 100    CL/C L       DE apple
    ‘Shufen ate 100 apples.’

We thus need a more plausible analysis of the de versions of various counting constructions.

5.2 The quantity-reading condition
In a context where the quantity is not emphasized, de may not follow an individual CL, individuating CL, or king CL, but may follow a unit word of other types, i.e., a partitive CL, collective CL, container measure, or standard measure.

(67) a. *Zhuozi-shang you  san ge de  pingguo.   [individual CL]
    table-on     have three CL DE apple
b. *Zhuozi-shang you  san di de you.    [individuating CL]
    table-on     have three CL DE oil
c. *Zhuozi-shang you  san kuan de fu zhuan.  [kind CL]
    table-on     have three kind DE clothes
(68) a. Zhuozi-shang you  san pian de xiang jiao.  [partitive CL]
    table-on     have three CL DE banana
    ‘There are three slices of banana on the table.’
b. Zhuozi-shang you  san dui de ying tao.  [collective CL]
    table-on     have three pile DE cherry
    ‘There are three piles of cherries on the table.’
c. Zhuozi-shang you  san bao de ping guo.  [container measure]
    table-on     have three CL DE apple
    ‘There are three bags of apples on the table;
d. Zhuozi-shang you  san bang de ying tao.  [standard measure]
    table-on     have three pound DE cherry
    ‘There are three pounds of cherries on the table.’

The division coincides with the one between the right-branching type and the left-branching type of counting constructions. Specifically, the individual CL ge in (67a), and
the individuating CL *di* in (67b) have a right-branching structure, and the king CL *kuan* in (67c) has an extended right-branching structure (see 2.5). They all disallow *de* in this context, where the quantity is not emphasized. In contrast, the partitive CL *pian* in (68a), the collective *dui* CL in (68b), the container measure *bao* in (68c), and the standard measure *bang* in (68d), all have a left-branching structure. They all allow *de* in the same context.

If the same right-branching type of counting constructions occur in a context where quantity is emphasized, their acceptability improves significantly. In (69), the quantity reading is attested in the presence of the adverb *yigong* ‘total’, and in (70), the quantity reading is attested in the predicate *zugou* ‘enough’.

(69) a. Zhuozi-shang yigong you 300 ge de pingguo.
    table-on total have 300 CL DE apple
    ‘There are 300 apples in total on the table.’

b. Zhuozi-shang yigong you 300 di de you.
    table-on total have 300 CL DE oil
    ‘There are 300 drops of oil in total on the table.’

c. Zhuozi-shang yigong you 300 kuan de fuzhuang.
    table-on total have 300 kind DE clothes
    ‘There are 300 kinds of clothes in total on the table.’

(70) a. Yi liang ge de pingguo jiu zugou le.
    one two CL DE apple just enough PRT
    ‘Just one or two apples are enough.’

b. Yi liang di de you jiu zugou le.
    one two CL DE oil just enough PRT
    ‘Just one or two drops of oil are enough.’

c. Yi liang kuan de fuzhuang jiu zugou le.
    one two kind DE clothes just enough PRT
    ‘Just one or two kinds of clothes are enough.’

The fact that the occurrence of *de* in the right-branching counting construction is sensitive to a quantity reading is further attested in the following fact. In the presence of a demonstrative, where an individual rather than a quantity-reading is more prominent, the contrast emerges again (Cheng & Sybesma 1998: 393 claim that no demonstrative may occur with a post-unit *de*. However, the native speakers here find (71) natural. All of the nominals in (71) can be googled):

(71) a. Ni ba na san xiang de shu qingli-diao!
    you BA that three box DE book clear-away
    ‘Damp those three boxes of books!’

b. Ni ba na yi dui de lüyou-shu qingli-diao!
    you BA that one pile DE travel-book clear-away
    ‘Damp that pile of travel books!’

c. Ni ba na san jin de fanqie qingli-diao!
    you BA that three kilo DE tomato clear-away
    ‘Damp those three kilos of tomatoes!’

d. Ni ba na liang bufen de kewen bei yixia!
    you BA that two part DE text recite once
    ‘Recite those two parts of the text!’

(72) a. *Ni ba na san ge de pingguo qingli-diao!
    you BA that three CL DE apple clear-away
    [individual CL]
The above contrast tells us that with respect to the occurrence of *de*, the left-branching type is less constrained, whereas the right-branching type is licensed only in a quantity reading. We try to explain this contrast in the next section.

Note that in Section 4.1 I argued against the claim that a left-branching structure is for a quantity reading and a right-branching structure is for a non-quantity reading. The observed pattern here further falsifies the claim.

5.3 Different sources of *de*

It is possible that there are two different types of *de* related to a counting construction, and the left-branching constructions can occur with both of them, while the right-branching one can occur with only one of them, the one that is related to a quantity reading.

In this section, I show that the *de* version of a counting construction can be a quantity-comparative modification construction. The modification analysis of the *de* version of measure word constructions has been seen in Cheng & Sybesma (1998: 393) and Tang (2005). In X. P. Li (2010), the *de* construction is called as-many/much-as construction. I now combine these two insights and propose that the construction is a specific type of modification construction: elliptical comparative construction.

Elliptical comparative constructions are independently observed in Mandarin Chinese. In (73a), the pro-form *name da* ‘so big’ takes *zhima* ‘sesame seed’ as its antecedent. In such a construction, the word *name* ‘so’ can be deleted, without affecting the reading. (73a) and (73b) have the same reading. In this construction, *de* introduces a comparative modifier. (73c) is may analysis of (73b).

(73) a. Shufen mai-le [yi ge [[zhima name da de] wanju]].
Shufen buy-PRF one CL sesame so   big DE toy
b. Shufen mai-le yi ge zhima da de wanju.
Shufen buy-PRF one CL sesame big DE toy
Both: ‘Shufen bought a toy as big as a sesame seed.’
c. Shufen mai-le [yi ge [[zhima name da de] wanju]].
Shufen buy-PRF one CL sesame so   big DE toy

Similarly, I claim that *de* in (74a) also introduces a comparative modifier. The full form of (74a) is (74b), and the first *pingguo* ‘grape’ and *name duo* ‘so many’ are deleted at PF. (75) shows the same point. In the following, I discuss (74) only.

(74) a. Shufen chi-le yi-bai ge de pingguo.
Shufen eat-PRF 100 CL DE apple
‘Shufen ate 100 apples.’
b. Shufen chi-le [[yi-bai ge pingguo name duo de] pingguo].
Shufen eat-PRF 100 CL apple so many DE apple
(75) a. Shufen chi-le san-fen-zhi-yi li de ganmao-yao.
Shufen eat-PRF one-third CL DE cold-pill
‘Shufen took one third of a cold-pill.’
Shufen eat-PRF one-third CL cold-pill so much DE cold-pill
In (74b), the antecedent of *name duo* ‘so many’ is *yi-bai ge pingguo* ‘one hundred CL apple’, which is a syntactic constituent.

The deletion of the noun, e.g. *pingguo* ‘apple’ in (74b), is an instance of Backward Deletion, in which the licensing string (‘antecedent’) occurs to the right of the ellipsis site, and both the licensing string and the ellipsis site must be right-peripheral in their respective domains (Wilder 1997: 92). In (76), for instance, backward deletion of the object in the relative clause of the subject is licensed by the object in the main VP (Wilder 1997: 87):

(76) [Anyone [who meets any of our sales people]]
    [really comes to like any of our sales people]

Similarly, in (74b), the ellipsis site of *pingguo* is right-peripheral in the domain of [*yi-bai ge pingguo*], and its licensing string *pingguo* is right-peripheral in the domain of the whole object and sentence.

The deletion of the string *name duo* ‘so many’ in (74b) is parallel to the deletion of *name* in (73b). The unparallel details can also be explained. In (73b), the dimension word *da* ‘big’ may not be deleted with *name* ‘so’, since its absence will lead to a different reading. Compare (73b) with (77).

(77) Shufen mai-le yi ge zhima de wanju.
    Shufen buy-PRF one CL sesame DE toy
    ‘Shufen bought a toy that is made of sesame seeds.’

Following the same recoverability principle in deletion (Hankamer 1973, Chomsky 1965, 1968), the dimension word *duo* in (74b) must be deleted together with *name*, since its presence may lead to a partitive reading of *duo*, an unintended reading. Compare (73b) with (78).

(78) Shufen chi-le yi-bai ge duo de pingguo.
    Shufen eat-PRF one-hundred CL more DE apple
    ‘Shufen ate more than 100 apples.’

It is thus the general recovery condition of PF deletion that decides why the dimension word must not be deleted in (73), and must be deleted in (74).

There is a similarity between the *de* version of a counting construction and the elliptical comparative construction in (73). As noted in Cheng & Sybesma (1998: 392), in the *de* version of a container measure construction, the referent of a container measure does not have to be present in the discourse. In (79a), no *de* occurs. Then either the cups or the bowl should be a container measure, but not both. The sentence is not acceptable. In (79b), *de* occurs, and the two container-denoting elements do not conflict: three cups is an abstract quantity, and the bowl is the physical container to consume the quantity.

(79) a. *Ta yong xiao wan he-le san bei jiu.*
    he with small bowl drink-PRF three cup wine
b. Ta yong xiao wan he-le san bei de jiu.
    he with small bowl drink-PRF three cup DE wine
    ‘He drank three cupfuls of wine from a small bowl.’

In the elliptical comparative construction in (73), the referent of *zhima* ‘sesame seed’
does not have to occur in the discourse. This is parallel to the de construction in (79b) above. What is relevant here is the property under the comparison: size in (73) and quantity in (79b).

Three arguments support this elliptical comparative analysis of the de version of individual and individuating CL constructions.

First, if an expression cannot occur in a full-fledged quantity comparative construction, it may not occur in a de construction. The forms in (80b) and (81b) make no sense, nor do those in (80a) and (81a). This correlation supports my hypothesis that the a-forms and b-forms are derivationally related.

(80) a. *yixie de shu <= b. *[yixie shu name duo de shu]
some DE book some book so many DE book
Lit.: ‘as many as some books’

(81) a. *mei (yi) ben de shu <= b. *[mei (yi) ben shu name duo de shu]
every one CL DE book every one CL book so many DE book
Lit.: ‘as many as every book’

Second, while a counting construction may have either a quantity reading or an individual reading (A. Li 1998), if it has an exclusively individual reading in a certain context, it may not host de. This suggests that de construction is not compatible with an individual reading. If de construction is a quantity comparative construction, the incompatibility is captured. I use (82) and (83) to show this point.

In (82a), a modifier occurs to the left of the numeral 100. Such a construction always has a specific and thus an individual reading (see the discussion of (52b) above). In (82b), the word yigong ‘altogether, in total’ signals a quantity context. In this context, a pre-numeral modifier may not occur, as shown in (82c).

(82) a. [Shufen mai de] 100 ge xigua
    Shufen buy DE 100 CL watermelon
    ‘the 100 watermelons that Shufen bought’

    b. Ta yigong chi-le 100 ge xigua.
    He total eat-prf 100 CL watermelon
    ‘He ate 100 watermelons in total.’

c. *Ta yigong chi-le [Shufen mai de] 100 ge xigua.
    he total eat-PRF Shufen buy DE 100 CL watermelon

The contrast in (83) shows that the de version of a CL construction is subject to the same constraint, although no quantity adverb such as yigong ‘total’ shows up. Such a construction may not host a pre-numeral modifier, as seen in (83b) (More examples showing a similar constraint are seen in Cheng & Sybesma 1998: 394; Tang 2005: 448). The constraint in (83b) is the same as the one in (82c). In both cases, a quantity context is in conflict with the exclusive individual reading of the pre-numeral modifier construction. The quantity context is provided by the adverb yigong ‘total’ in (83b), and by the post-CL de in (83b). My quantity comparative analysis explains the impossible co-occurrence of the pre-numeral modifier and the post-CL de.

(83) a. 100 ge de xigua
    100 CL DE watermelon
    ‘100 watermelons’

    b. *[Shufen mai de] 100 ge de xigua
    Shufen buy DE 100 CL DE watermelon
Third, the noun to the right of de can be silent in other de constructions, as in (84a), but not in the de version of a counting construction, as shown in (84b) (Tang 1990, Cheng & Sybesma 1998: 397, fn. 6). In my analysis, this is because the undeletable noun is the licensor of the elided noun in the comparative modifier.

(84) a. Zuo-bian you hong de fanqie, you-bian you huang de (fanqie).
   left-side have red DE tomato right-side have yellow DE tomato
   ‘There are red tomatoes on the left side and yellow ones on the right side.’

b. Zuo-bian you 100 ge de fanqie, you-bian you 200 ge de *(fanqie).
   left-side have 100 CL DE tomato right-side have 200 CL DE tomato
   ‘There are 100 tomatoes on the left side and 200 on the right side.’

In this elliptical comparative perspective, de introduces a modifier to the left of another element (i.e., the modifiee). The whole construction is further derived by ellipsis. This is the same de that occurs in the elliptical comparative construction (73b). Crucially, the noun following de is actually not in a counting construction at all. The noun that is in a counting construction has been deleted, and the containing counting construction is embedded in the modifier. So the position of de in this case does not show the constituency of the elements inside a counting construction (contra Hsieh 2008: 45; X. P. Li 2010: 205).

We have seen that the de version of the right-branching structure is constrained by the quantity-reading condition, but for the de version of the left-branching structure, this quantity condition is not forced. One possible account of the contrast is that for the left-branching constructions, there are two sources of de: one is like that of the right-branching structure, i.e., it is a modification marker, and the other is not a modification marker.

Non-modification marker uses of de are also found in other constructions, as seen in (85).

(85) a. Shufen de fangwen
   Shufen DE visit
   ‘the visit of Shufen’

b. [Shufen lai] de xiaoxi
   Shufen come DE news
   ‘the news that Shufen has come’

In (85a), Shufen is not a modifier of fangwen ‘visit’. In (85b), Shufen lai ‘Shufen comes’ is not a modifier of xiaoxi ‘news’, either. There is no evidence to show that such expressions are derived by comparative deletion. Importantly, de occurs between the two syntactic constituents in the examples.

My hypothesis is that when de occurs in a left-branching counting construction, it is ambiguous between the de that introduces a comparative modifier and the de that does not. It is in the latter case that de occurs between two syntactic constituents of a counting construction. In the former case, de is a comparative modification marker, which is external to the counting construction. The two forms in (86) show the contrast:

(86) a. [san bei] de jiu
   three cup DE wine
   ‘three cups of wine’
b. \([\text{san bei jiu\_name duo}] \text{ de jiu}\)
   
   three cup wine so much DE wine

   ‘three cupfuls of wine’

In (86a), *de* occurs between two syntactic constituents of a counting construction, *san bei* ‘three cup’ and *jiu* ‘wine’, whereas in (86b), *de* is out of the counting construction *san bei jiu* ‘three cup wine’.

I have proposed a fine-grained analysis of the *de* version of counting constructions, to capture the constraint on the occurrence of *de* with individual, individuating, and kind CL constructions, and the absence of the constraint on other types of counting constructions.

6. Summary

In this paper I have investigated the constituency of counting constructions in Mandarin Chinese. Such constructions contain three elements: a numeral, a noun, and a unit word between them. I have discussed four issues: <i> the scope of a left-peripheral modifier; <ii> the dependency between the modifier of unit word and that of a noun; <iii> the complement and predicate status of the combination of a numeral and a unit word; <iv> the semantic selection of a unit word on a noun. Based on the different behaviors of the different types of unit words, I have identified three structures: a left-branching structure for container measures, standard measures, partitive CLs, and collective CLs; a right-branching structure for individual and individuating CLs; and a structure in which no two of the three elements form a constituent for kind CLs. I have also falsified invalid arguments such as the co-occurrence of a numeral and a unit word and the position of the partitive markers *duo* ‘more’ and *ban* ‘half’. I have also argued against the quantity-individual semantic mappings with the different syntactic structures. Finally, I have presented a comparative deletion analysis of the constructions in which the functional word *de* follows a unit word.

Putting kind CL constructions aside, the division between the left- and right-branching structures argued for in this paper has no correlation with the division between the alleged sortal and mensural CL constructions. According to Grinevald (2002: 261), individual CLs are sortal ones and individuating CLs are mensural ones. In my analysis, both kinds of CLs have a right-branching structure. My division also does not match Ōta’s (2003 [1958]: 147) division between measuring (*ji-liang 計量*) and counting (*ji-shu 計數*) constructions: the former is for standard measure and container measure and the latter is for the rest, including individual and collective CL constructions. In my analysis, collective CL constructions have the same structure as that of standard and container measures. Since the sortal-mensual division and the measuring-counting division are not supported by any syntactic evidence, it is not surprising that they do not correlate with the syntactic analysis presented here.

A further issue to be investigated is the feature makeup of the unit words in the three structures, and the categorial labels of the nodes of the different structures. These issues are important, but the constituency issue has to be settled first.

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