SYNTACTIC-SEMANTIC ANALYSIS OF CLASSIFIERS IN MANDARIN

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Abstract

In this paper, I propose an analysis of the syntax and semantics of the classifier-noun construction in Mandarin. I first argue that the classifier is a complement to the numeral, not a head, following Krifka (1995). I then argue that classifiers have lexical semantic content. I discuss two types of semantic relations between the classifier and the noun. In one type, the noun is in a member relation with the classifier and takes the taxonomic function between the kind and the classifier level as a presupposition, while in the other type, the noun and classifier are in the intersection relation, in which the classifier serves a role similar to an adjective modifying the noun.

1 Introduction

Mandarin is well-known as a typical classifier language. Classifier constructions are a common phenomenon in Mandarin in which a quasi-function word known as a classifier is necessary between numerals and nouns to indicate the quantity of some entity(-ies). Classifiers, strictly described as numeral classifiers (Aikhenvald 2000), are also known in Mandarin as measure words or quantitative words (量词). They also are present in other languages such as Japanese, Malay, Tzeltal, etc. (Aikhenvald 2000), none of which allow numerals to combine directly with nouns to construct a noun phrase that indicates a quantity. For example, in both Mandarin and Japanese, noun phrases use a numeral and classifier together to denote the numerical quantity of the nominal referent. This is shown in examples (1) and (2).[1]

[1] The glossing abbreviations in this paper are as follows: Cl or CL: 'classifier'; PAR: 'particle', GEN: 'genitive', Num: 'numeral', and N: 'noun'.

(1) a. *两 狗 (Mandarin)
liǎng gǒu
2 dog
intended: ‘two dogs’

b. 两 条 狗
liǎng tiáo gǒu
2 CL.*tiao* dog
‘two dogs’

(2) a. *ni-inu/kuruma (Japanese)
2 dog/car
intended: ‘two dogs/cars’

b. ni-hiki-no inu / ni-dai-no kuruma
2-CL-GEN dog / 2-CL-GEN car
‘two dogs/cars’

Researchers have analyzed classifiers in Mandarin from many perspectives. Krifka (1995) compares the formal semantics of Mandarin bare nouns to English nouns, by analyzing the classifier construction and, for instance, giving a formal semantic analysis for the individual and kind classifier *zhong* 种 ‘herd’. Cheng and Sybesma (1999) and Li (2013), on the other hand, analyze classifier construction from a syntactic perspective instead of a semantic one. Cheng and Sybesma (1999) consider the classifier and noun structure as a Classifier Phrase (ClP), in which the classifier is the head of the phrase and selects for the noun. Sudo (2016) argues that in Japanese, the obligatory classifier relies on the semantics of the numeral instead of the semantics of the noun.

Li (2011) and Li (2013) give a general and widespread introduction to Mandarin classifiers; however, they do not provide an account of the lexical semantics of classifiers and regard them as a closed category, like function words. They do provide a formal semantic analysis for some types of classifiers, though they do not give a general lexical semantics for all classifiers. Li (2011) and Li (2013) do not use this formal semantic analysis to illuminate any relation between classifiers and nouns, such as the count/mass distinction.Contrary to the claims in Li (2013), I argue that classifiers are an open-class, not a closed-class, category.

This paper aims to answer two questions. First, why are classifiers obligatory between numerals and bare nouns to construct a noun phrase indicating quantities in Mandarin? Previous literature including Chierchia (1998), Krifka (1995) and Cheng and Sybesma (1999) claim that the classifier in Mandarin encodes the count/mass distinction. However, Sudo (2016) argues that it is the numeral that selects the classifier in Japanese, which I agree with and extend to Mandarin. To test Cheng and Sybesma’s (1999) syntactic structure hypothesis about ClP and whether Sudo’s hypothesis generalizes to Mandarin, in section 2, I examine the internal structure of classifiers.

The second question that I address is whether the classifier is a semantic requirement, which I argue in favor of. If classifiers have lexical meanings, does the semantics of the classifier affect the meanings of the whole classifier construction? I argue that the semantics of the classifier does affect the meaning of the whole construction and that there are two types of semantic relations between the classifier and the noun. I provide a semantics of classifiers in section 3. In section 4, I argue that classifiers are an open-class category, as shown by their lexical content. Appendices A and B provide a list of classifiers and their semantic values and requirements.

2 Syntactic Analysis of Classifiers

2.1 Proposal for the Syntactic Structure of the Classifier Construction

The two basic options for the constituent structure of classifier constructions are [Num [CL N]] and [[Num CL] N]. In this section, I argue in favor of the latter. Krifka (1995), who uses formal semantics to analyze noun phrases in Mandarin, treats the numeral and classifier together as a measure phrase, which is the latter structure. Greenberg and Kemmer (1990) also describe the NP in Mandarin as [[Num CL]-NP], in which the classifier is also the complement to the numeral. Following Greenberg and Kemmer (1990) and Krifka (1995), I hypothesize that the classifier construction is a phrase headed by the numeral selecting for ClP, which only contains the classifier, not the noun.

The next question is whether the classifier or the numeral is the head of Num-CL constituent. I claim that as the classifier is selected by the numeral, the Num-CL constituent is headed by the numeral. In other words, the classifier is the complement of the numeral and encodes lexical meanings as well. The classifier is not required by the noun. On the contrary, it selects for the noun. The proposed structure is given in Figure 1.

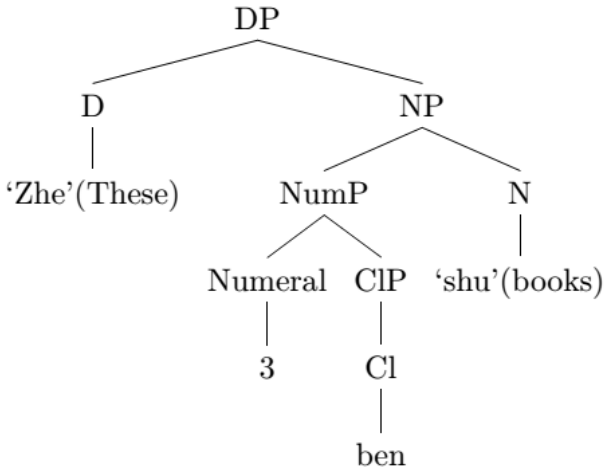

Figure 1. Proposed structure of Mandarin Classifier-N construction: 'these three books'.

The syntactic structure in Figure (1) is similar to Cheng and Sybesma's (1999) analysis in that the numeral is the head of the NumP, indicating the quantity of the noun. This is also true from the point of view of semantics, in that the core meaning of the expression is the quantity. However, how does the noun combine with the Num-CL constituent? Does the noun select for the numeral or is it selected by the numeral? In the next sub-section, I compare my analysis with the existing accounts. I illustrate how this structure works in the compositional semantics in Section 3.

2.2 Comparison with Previous Accounts

Cheng and Sybesma (1999) argue that the external syntax of classifier constructions is ClP, where the classifier combines with the noun, as shown in Figure 2.

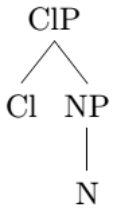

Figure 2. Structure for bare noun with definite reading in Mandarin (Cheng 1999)

Cheng and Sybesma (1999) posit that the classifier selects for the bare noun. That is, the category of the CL+N complex is ClP, not NP. Bare nouns in Mandarin can only express a definite interpretation, while CL+N can express both indefinite and definite. The difference is that the Cl+N construction requires the generic interpretation. With the lack of number morphology in Mandarin, Cheng and Sybesma (1999) suppose that the bare noun structure in Mandarin is ClP, with an empty classifier head. Assuming that the count-mass distinction is derived from classifiers, they argue for a distinction between count and mass in Chinese nouns (both in Mandarin and Cantonese). On their analysis, classifiers should be split into two kinds: mass-classifiers and count-classifiers.

Yet, this classification does not explain why there is a lexical restriction between classifiers and nouns. From a semantic perspective, it is not arbitrary which classifier modifies a given noun, since different classifiers are used to modify different nouns. Under Cheng and Sybesma's (1999) account, the classifier is obligatory to the noun only to express generic interpretations, which ignores other semantic relations between the classifier and the noun. Their account answers the question of why definite noun phrases are ClP, but cannot explain the semantics of the Mandarin classifier with relation to the noun. Wu and Bodomo (2009) argue against Cheng and Sybesma (1999, 2005), positing that Mandarin classifiers do not have the same function as definite determiners.

Krifka's (1995) semantic analysis also differs from Cheng and Sybesma's (1999) purely syntactic analysis. Krifka states that the syntactic structure of the classifier construction is [$_{NP}$ MP [N]] (where MP = [Num ClP]) instead of [$_{NumP}$ Num[$_{ClP}$ Cl [N]]] or [$_{ClP}$ Cl [N]] for the bare noun. Following Krifka (1995) and Sudo (2016), I argue that the classifier is selected by the numeral, contra Cheng and Sybesma (1999). Using data from when the numeral is elided, I argue for the syntax of classifier phrases is [$_{NumP}$ [Num [$_{ClP}$ Cl]] [$_{NP}$ N]]. In Mandarin, ClP can be used only with a numeral. The only exception where the classifier can be used alone with the noun is the singular quantitative expression, such as 'buy (one) CL-ben book' in example (3). The empty numeral here is interpreted as 'one' by default. In other words, the ClP cannot express that there is more than one entity without the numerals. Thus, I argue the classifier is a complement to the numeral instead of a head selecting a NumP.

(3) Mǎi le běn shū
buy PAR.*le* CL.*ben* book
'bought one book'

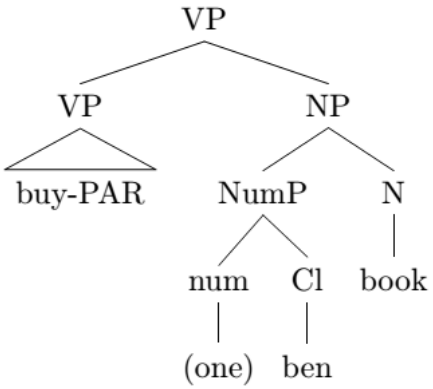

Figure 3. Proposed structure of Mandarin Classifier-N construction: 'bought one book'.

3 Semantic Analysis of Classifiers

Having looked at the syntactic structure of classifiers in Mandarin, we now turn to their semantics. As a specific classifier modifies a specific type of noun, and as there is no associated morphological change in Mandarin, I argue that there is a meaning relation between the classifier and the noun. For example, to modify the noun 'fish', we cannot use the classifier 'ke', which is for plants. In a corpus study, I isolated five types of classifiers: taxonomic classifiers, modificational classifiers, group classifiers, unit classifiers, and quantitative classifiers. In this paper, I focus on the two primary semantic relations between the classifiers and the nouns, taxonomic and modificational, which I will discuss in section 3.3 and 3.4.

3.1 Krifka (1995)

Krifka (1995) illustrates Mandarin bare nouns in five circumstances: (a) the kind, (b) some specimens of the kind, (c) a set of specimens of this kind, (d) a number of individual specimens of this kind and (e) subspecies of this kind. The last three (c), (d), and (e) are three types of classifier constructions. Krifka first claims that a Mandarin bare noun can denote both the kind (a) and the definite species (b) reading. Then he analyzes the three classifier constructions by treating the measure phrase (the [Num-Cl] constituent) and classifier as a function to yield the number of the kind or the object units of the kind. In other words, Krifka (1995) regards the classifier as a function indicating the number of sets, unit objects or subspecies, and pointing to the noun's taxonomic features. Examples of the three types of classifier are shown below in (4-6).

(4) Set level:
Sān qún xióng
three CL.*qun* bear
'three herds of bears'

(5) Individual level:
Sān zhī xióng
three CL.*zhi* bear
'three bears (individuals)'

(6) Subspecies level:
Sān zhǒng xióng
three CL.*zhong* bear
'three bears (species)'

Krifka (1995) argues that there are (at least) three types of unit functions under the union of Realization and Taxonomic function observable for the same noun *xiong* 'bear'. These three types are *qun* or 'herd', a measure function of a set of or number of specimens (4); *zhi* or 'object unit', the individual level (5), or individual specimens; and, *zhong* or 'kind unit', the subspecies level (6). I summarize this function below in (7), in which I use the general term 'unit' to represent the 'set', 'object unit' and 'kind unit' function.

The representation of the semantic relation that holds between the classifier and the noun of Krifka (1995) is given below, where *n* stands for the number of the entities (the numeral), *y* stands for the specific noun, and *R* and *T* are the realization relation and the taxonomic relation, respectively. Based on Krifka (1995), *R(x,k)* applies to specimens or individual sums of specimens of *k*, and *T(x, k)* applies to subspecies or individual sums of subspecies of *k*. The two relations are conflated as a relation *RT: RT(x,y)* ⇔ *R(x,y)* ∧ *T(x,y).*

(7) $[\![\text{Cl}]\!] = \lambda n \lambda y \lambda x. [RT(x, y)\ \&\ Unit(y)(x) = n]$

I argue that Krifka's analysis only holds for some of the types of classifiers, namely the basic unit classifier like *zhong*. I argue that the other types of classifier, like *lun*, *wan*, etc., have different semantics. These classifiers not only function as a measure function yielding the number and denoting the taxonomic kind of the individual objects, but can also complement the meaning of the noun. Thus, the classifier cannot only be a measure function. My revisions of Krifka's (1995) hypothesis are shown below in (8-9). I claim that one type of classifier is a property P which takes the object y as the argument (8):

(8) $[\![\text{Cl: } \mathbf{Modificational}]\!] = \lambda P \lambda n \lambda y \lambda x. P(y)[RT(x, y)\ \&\ Unit(y)(x) = n]$

The other type of classifier takes the Taxonomic function between the kind and the classifier as the presupposition, then performs the measure function (9):

(9) $[\![\text{Cl: } \mathbf{Taxonomic}]\!] = \lambda z \lambda n \lambda y \lambda x. T(y, z)[RT(x, y)\ \&\ Unit(y)(x) = n]$

There are thus two types of semantic relations between the classifier and the noun. The first denotation, given in (8), is an intersection relation in which the classifier set intersects with the noun first and takes the numeral as its argument to constitute a measure function. The second denotation, given in (9), is where the kind of noun stands in a member relation to the classifier and takes the taxonomic function between the kind and the classifier level as a presupposition. I illustrate the semantics of classifiers in the rest of this section.

3.2 Lexical Semantics of Classifiers: *book, vehicle, moon, paper, spring*

I illustrate my revision of Krifka's analysis with the following examples. The examples with 'book' (10) and 'vehicle' (11) have basic unit classifiers, which are taxonomic and do not add to the lexical meaning of the nouns they modify. The classifiers in the examples with 'moon' (12), 'paper' (13) and 'spring water' (14) are modificational and add to the lexical meanings of the nouns they modify, expressing their shape or form.

(10) Classifiers for written things

a. Yī běn shū
one CL.*ben* book
'a book'

b. *Yī běn bàozhǐ
one CL.*ben* newspaper
intended: 'a (unit of) newspaper'

In the *Ciyuan Chinese Dictionary of Etymology, Chinese Edition* (1995), henceforth *Ciyuan* (1995), *ben* has seven meanings. One gloss refers to essays, writings, paintings, inscription rubbings and memorials and can also be used as the counting unit for them. Because of the ancient handwriting and printing technology, *ben* as a classifier or measure word can only be used for one piece of painting or writing. Printed materials today such as books, journals, magazines, pamphlets, and notebooks correspond to the bound material description of writings as (10a). However, 'newspaper', whose appearance is pieces of paper, not a bound book, cannot be modified with *ben*, shown as (10b). Instead, 'newspaper' takes the classifiers *die* or *da*, which mean 'pile'.

Example (11) below shows classifiers for vehicles.

(11) Classifiers for vehicles

a. Yí liàng chē
one CL.*liang* car (or bike/trunk/bus/… land transportation)
'one car (or bike/trunk/bus/… other land transportation)'

b. Yī sōu chuán
one CL.*sou* boat (or ship/canoe/steamer/vessel/craft… maritime transportation)
'one boat (or ship/canoe/steamer/vessel/craft … maritime transportation)'

c. *Yí liàng chuán
one CL.*liang* boat (or ship/canoe/steamer/vessel/craft … maritime transportation)
intended: 'one boat (or ship/canoe/steamer/vessel/craft … maritime transportation)'

The Mandarin word *liang* originally meant one horse-drawn carriage, as stated in *Ciyuan* (1995). The character *liang* 辆 developed from the numeral word *liang* 两, which means 'two'. The ancient Chinese used *liang* 辆 to describe the unit for carriages. While in present times, the most frequently used vehicles are cars instead of carriages, the original meaning of *liang* still determines its modern usage. Therefore, *liang* cannot be used universally for all kinds of vehicles, but is restricted to land transportation, as in example (11a). Any other subset of vehicles, like those used for air transportation (airplanes), and maritime transportation (boats, ships, canoes, steamers,

vessels and crafts, etc.) cannot be modified by *liang.* For example, 'boats' cannot be modified by *liang* as in (11c). Instead, maritime transportation nouns use a different classifier, *sou* (11b).

I now give examples to show classifiers can function as predicate modifiers to nouns (12-15).

(12) Classifiers for 'moon'

a. Yī wān yuèliàng
one CL.*wan* moon
'a (crescent) moon' ('wan' describes the shape of the moon as a curve)

b. Yì lún yuèliàng
one CL.*lun* moon
'a (full) moon' ('lun' describes the shape of the moon as a ring)

Example (12) above illustrates that using two different classifiers to modify the same noun *yueliang* 'moon' can express two distinct and contrastive meanings. In the example, one moon is crescent (12a), while the other is full (12b). The classifier *wan* in (12a) originates from the verb 'bend' (*Ciyuan* 1995). *Wan* can also be used as an adjective which means 'bent'. The original meaning of *lun* in (12b) is the wheel of a carriage, later developed to refer to all round objects, like a ring. It is the lexical semantics of the two classifiers that distinguishes the meanings of these two expressions.

(13) Classifiers for 'paper'

a. Yī juǎn zhǐ
one CL.*juan* paper
'a roll of paper' ('juan' describes the shape of the paper as a roll)

b. Yì zhāng zhǐ
one CL.*zhang* paper
'a piece of (flat) paper' ('zhang' describes the shape of the paper as flat)

(14) Classifiers for 'spring'

a. Yī dī quánshuǐ
one CL.*di* spring
'a drop of spring water' ('di' describes the flow of the spring as a water drop)

b. Yī gǔ quánshuǐ
one CL.*gu* spring
'a stream of spring water' ('gu' describes the flow of the water as a stream)

c. Yī gǔ guāng
one CL.*gu* light
'a beam of light'

The examples (13-14) containing 'paper' and 'spring water' are similar to (12). Different classifiers are used to modify the same noun and express different meanings. The original meaning of the classifier *juan* is a roll (*Ciyuan* 1995). It can be used as a verb 'to roll' and an adjective 'rolled'. In example (13a), *juan* is used as a classifier to describe the paper as in a roll. *Zhang* is originally a verb 'to open', which extends to the meaning of 'flat things' in (10b). *Di* originally

meant a 'water drop', and can be used as the verb 'to drip'. In example (14a), 'spring water' is restricted to mean a water drop and cannot be used as a verb to indicate a flowing status. *Gu* originally meant 'rope' is used to describe things that share the feature of cylindrical shape, like rope. Example (14b) and (14c) use *gu* to describe a stream of spring water and a beam of light as the liquid and the light have the same cylindrical shape.

We have seen the examples that illustrate the lexical meanings of the classifiers. Now we will analyze the semantic relations among these classifiers to determine whether they are the same. First, we will look at examples (10-11), involving 'book' and 'vehicle'. The meanings of the classifiers are a more general taxonomic category subsuming the meanings of the nouns, which means that the meanings of *ben* (bound sheets on writings) and *liang* (land transportation) are entailed by 'book' and 'cars' respectively. This shows some replication of meanings between the classifiers and the nouns. I thus argue that the semantic relation between the noun and the classifier is Taxonomic, occurring as a presupposition as shown in (15). For example, the car is an element in the set *liang,* and book is an element of the set *ben*.

(15) $[\![\text{Cl: ben}]\!] = \lambda n \lambda y \lambda x. T(y, \text{bound sheets of writing})[RT(x, y)\ \&\ Unit(y)(x) = n]$

The semantic relation between the noun 'moon' and the classifiers *wan* and *lun* in (12) is similar to the relation between the adjective modifier and the noun, which is the intersection of the two sets. The set of 'moon' only contains one object, the moon, while the *wan* set contains all the objects that are crescent-shaped (16). The semantics of the classifier construction is the intersection of the 'moon' set and the 'crescent' set, which is a crescent moon.

(16) $[\![\text{Cl: wan}]\!] = \lambda n \lambda y \lambda x. \text{BENT}(y)[RT(x, y)\ \&\ Unit(y)(x) = n]$

The examples above illustrate two different semantic relations between the classifier and the noun. *Ben* and *liang* are the entailment of books and cars, in which the kinds of the noun are the members of the classifiers, while *lun* and *wan* are modifiers to the moon, in which the moon and the classifiers are separate sets and combine as an intersection.

Krifka's (1995) semantic analysis of Mandarin classifiers will fail to explain the examples above. The measure function hypothesis cannot explain why *liang* cannot modify ships (11c), and why when speakers use different classifiers to modify the same referent, the feature of the referent changes even though both of the two classifiers can grammatically and semantically successfully modify the object.

3.3 Taxonomic Classifiers: 'ju', 'duan', 'pian'

I illustrate more examples of taxonomic classifiers, similar to *ben* in (15): *ju*, *duan*, and *pian.* Example (17) below shows how taxonomic classifiers are used for describing different statements of 'text'.

(17) Classifiers for text/writing

a. Yí jù huà
one CL.*ju* text/writing
'one sentence of text/writing' (= 'one sentence')

b. *Yī zhī/liàng/lún huà
one CL.*zhi/liang/lun* text/writing
intended: 'one sentence'

c. Yī duàn huà
one CL.*duan* text/writing
'one paragraph of text/writing' (= 'one paragraph')

d. Yí gè jù-zi
one CL.*ge* sentence
'one sentence'

e. Yí gè duàn-luò
one CL.*ge* paragraph
'one paragraph'

f. Yì piān wènzhāng
one CL.*pian* article
'one article'

The Mandarin word *ju* originally meant one sentence or the pause in a sentence (*Ciyuan* 1995). The ancient Chinese meaning of *ju* still holds now: speakers use *ju* to measure sentences and express that they are complete (17a). Example (17b) shows that it is ungrammatical to use other classifiers to express the same meaning, including the general unit classifier *zhi* and other classifiers like *liang* and *lun*, which we have seen before. Typically, the general unit classifier *zhi* only modifies animate objects and other classifiers have different applications.

However, there is another classifier that modifies *hua* 'text' in Mandarin: *duan* 'paragraph', shown in (17c). Usually used as a noun, *duan* originally meant a part of a cloth, and now extends to mean part of something abstract, including time, length and objects. Similarly to how *duan* originally referred to a real object, *pian* originally meant bamboo slips, on which the ancient Chinese wrote before the invention of paper (17f). Its meaning now extends to articles of text. Example (17d) and (17f) show that the two classifiers *ju* and *duan* used to modify 'text' can actually be used in the nouns *ju-zi* and *duan-luo*. Both 'sentence' and 'paragraph' mean parts of writing, which satisfies the member relation between the classifier and the noun perfectly. (18) shows the semantics of *ju*, *duan* and *pian*.

(18) Lexical entries for classifiers

a. $[\![\text{Cl: ju}]\!] = \lambda n \lambda y \lambda x. T(y, \text{sentences})[RT(x, y)\ \&\ Unit(y)(x) = n]$

b. $[\![\text{Cl: duan}]\!] = \lambda n \lambda y \lambda x. T(y, \text{paragraphs})[RT(x, y)\ \&\ Unit(y)(x) = n]$

c. $[\![\text{Cl: pian}]\!] = \lambda n \lambda y \lambda x. T(y, \text{articles})[RT(x, y)\ \&\ Unit(y)(x) = n]$

3.4 Modificational Classifiers: 'feng'

Next we will see another example of an intersection classifier similar to *wan* for crescent-shaped objects (16): *feng*, used for 'letters' (19).

(19) Classifiers for letters

a. Yì fēng xìn
one CL.*feng* letter
'one letter' (= 'formal letter of correspondence, once contained in an envelope')

b. *Yì fēng zhǐ
one CL.*feng* paper
intended: 'one piece of paper'

c. Yī jiàn/gè xìn
one CL.*jian/ge* letter
'one letter' (= 'informal letter of correspondence, not necessarily once contained in an envelope')

d. Yí gè xìn-fēng
one CL.*ge* envelope
'one envelope'

The word *feng* as a verb means 'to close' (*Ciyuan* 1995), which brings an item into a state of being airtight. *Feng* originally could be used as a verb, an adjective, a noun or a classifier. As a classifier, *feng* can only be used for formal letters of correspondence in an envelope. Letters are objects typically enclosed in an envelope due to their confidentiality. This strict usage of the classifier remains. In example (19b), it is ungrammatical to use *feng* for 'paper', as 'paper' is not an enclosed item which can meet the requirement of *feng*.

The general unit classifiers *jian* and *ge* can also be used for letters (19c-d). In these cases, the letter is either confidential or not. This shows that the classifier indicates whether the letter is confidential or not, which means the classifier contributes to the meaning of the noun. Example (19d) also shows that the classifier *feng* can combine with *xin*, the letter of correspondence, to compose the word 'envelope', which again shows the classifier *feng* contributes to the meaning of the noun *xin*. Thus, the semantic relation between the classifier *feng* and the noun *xin* is intersection, as shown below in (20).

(20) $[\![\mathrm{Cl}-\mathrm{feng}]\!] = \lambda n \lambda y \lambda x.\, \mathrm{CLOSED}(y)[RT(x,y)\ \&\ Unit(y)(x) = n]$

3.5 Compositional Semantic Analysis of Taxonomic Classifiers: *ben, liang*

In the previous sections, I have given the syntactic structure [[Num CL] N] for the classifier construction and illustrated the lexical semantics of the classifiers with some examples. Now I illustrate the compositional semantics of the example classifiers. First, I use 'book' (21) and 'car' (22) to show the compositional semantics of the member relation between the classifiers *ben* (21) and *liang* (22) and the nouns.

(21) 'three books' [Num:three Cl:ben N:book]
$[\![\text{Num: three}]\!] = three$
$[\![\text{Cl: ben}]\!] = \lambda n \lambda y \lambda x.T(y, \text{bound sheets of writing})[RT(x,y)\ \&\ Unit(y)(x) = n]$
$[\![\text{Num: three Cl: ben}]\!] = [\![\text{Cl: ben}]\!]([\![\text{Num: three}]\!])$
$= \lambda y \lambda x.T(y, \text{bound sheets of writing})[RT(x,y)\ \&\ Unit(y)(x) = 3]$
$[\![\text{N: book}]\!] = \lambda x.[\text{book}(x)]$
$[\![\text{Num: three Cl: ben N: book}]\!] = [\![\text{Num: three Cl: ben}]\!]([\![\text{N: book}]\!])$
$= \lambda x.T(book, \text{bound sheets of writing})[RT(x, book)\ \&\ Unit(book)(x) = 3]$

(22) 'one car' [Num:one Cl:liang N:car]
$[\![\text{Num: one}]\!] = one$
$[\![\text{Cl: liang}]\!] = \lambda n \lambda y \lambda x.T(y, \text{land transportation})[RT(x,y)\ \&\ Unit(y)(x) = n]$
$[\![\text{Num: one Cl: liang}]\!] = [\![\text{Cl: liang}]\!]([\![\text{Numeral: one}]\!])$
$= \lambda y \lambda x.T(y, \text{land transportation})[RT(x,y)\ \&\ Unit(y)(x) = 1]$
$[\![\text{N: car}]\!] = \lambda x.[\text{car}(x)]$
$[\![\text{Num: one Cl: liang N: car}]\!] = [\![\text{Num: one Cl: liang}]\!]([\![\text{N: car}]\!])$
$= \lambda x.T(car, \text{land transportation})[RT(x, car)\ \&\ Unit(car)(x) = 1]$

If we substitute 'cars' in (23) with 'buses' or 'bicycles', the semantic analysis will be the same except for the extensions of 'buses' and 'bicycles'. However, it is unacceptable to use the same classifier *liang* to modify 'boats', 'ships' or 'planes' in Mandarin. The specific classifier for 'boats' and 'ships' is *sou* while the one for 'plane' is *jia*. The extension of *sou* is all the objects in the world *i* which are kinds of maritime transport. The extensions of *jia* are used for a great deal of different kinds of objects, which are not restricted to land or maritime transportation.

3.6 Compositional Semantic Analysis of Modificational Classifiers: *wan, lun*

In the analysis above, classifiers do not add lexical meaning: they merely repeat the semantic entailment of the noun. However, other classifiers do add lexical meaning. Mandarin uses specific classifiers to modify specific nouns. Based on the same syntactic structure proposed above and the fact that Mandarin nouns are never inflected, classifiers that modify the meaning of the noun in Mandarin must contain meanings which do something in the semantics, particularly in relation to the specific noun. While some of the classifiers merely duplicate the meanings of the nouns, others contribute to them. For example, we can apply my proposal of the semantic contribution of the classifiers *wan* and *lun* to the example noun 'moon' (see Example 12 above). The compositional semantic analyses of 'one crescent moon' (23) and 'one full moon' (24) will look like this:

(23) 'one crescent moon' [Num:one Cl:wan N:moon]
$[\![\text{Num: one}]\!] = one$
$[\![\text{Cl: wan}]\!] = \lambda n \lambda y \lambda x.\ \text{BENT}(y)[RT(x,y)\ \&\ Unit(y)(x) = n]$
$[\![\text{Num: one Cl: wan}]\!] = [\![\text{Cl: wan}]\!]([\![\text{Num: one}]\!])$
$= \lambda y \lambda x.\ \text{BENT}(y)[RT(x,y)\ \&\ Unit(y)(x) = 1]$
$[\![\text{N: moon}]\!] = \lambda x.[\text{moon}(x)]$
$[\![\text{Num: one Cl: wan N: moon}]\!] = [\![\text{Num: one Cl: wan}]\!]([\![\text{N: moon}]\!])$
$= \lambda x.\ \text{BENT}(moon)[RT(x, moon)\ \&\ Unit(moon)(x) = 1]$

(24) 'one full moon' [Num:one Cl:lun N:moon]
$[\![\text{Num: one}]\!] = one$
$[\![\text{Cl: lun}]\!] = \lambda n \lambda y \lambda x.\, \text{ROUND}(y)[RT(x, y)\ \&\ Unit(y)(x) = n]$
$[\![\text{Num: one Cl: lun}]\!] = [\![\text{Cl: lun}]\!]([\![\text{Num: one}]\!])$
$= \lambda y \lambda x.\, \text{ROUND}(y)[RT(x, y)\ \&\ Unit(y)(x) = 1]$
$[\![\text{N: moon}]\!] = \lambda x.\, [\text{moon}(x)]$
$[\![\text{Num: one Cl: lun N: moon}]\!] = [\![\text{Num: one Cl: lun}]\!]([\![\text{N: moon}]\!])$
$= \lambda x.\, \text{ROUND}(moon)[RT(x, moon)\ \&\ Unit(moon)(x) = 1]$

3.7 Problems: General Unit Classifiers – 'ge', 'zhi'

Under my proposal, all classifiers, including the unit classifiers *ge* and *zhi*, express lexical meanings in addition to the generic interpretation. The generic interpretation is already represented with the measure function. But, do the general unit classifiers *ge* and *zhi* have any lexical meanings, or are they only function words? I claim that *ge* and *zhi* express meanings, but in weak ways. Compare the expressions in example (25).

(25) 'Book' and general classifiers

a. *wǔ zhī shū
five CL.*zhi* book
intended: 'five books'

b. #wǔ gè shū
five CL.*ge* book
intended: 'five books'

c. wǔ běn shū
five CL.*ben* book
'five books'

There are some differences among these expressions even if the classifiers *zhi* and *ge* are the most general ones. *Zhi* as a unit classifier is hardly acceptable here to describe one book. *Ge* can be acceptable, but *ben* is more appropriate and acceptable to modify books because *ben* has the entailment of a book which is a collection of bound sheets of writings.

Let us compare *ge* and *zhi* now. *Ge* and *zhi* can differ from each other in expressions even if they are both unit classifiers, as in Example (26).

(26) 'Cat' and general classifiers

a. #wǔ gè māo
five CL.*ge* cat
intended: 'five cats'

b. wǔ zhī māo
five CL.*zhi* cat
'five cats'

While both expressions make sense under a circumstance in which someone is indicating that an indefinite number of cats is five, the second expression is more acceptable. *Zhi* is used to modify **animate** objects while *ge* is more general. **Animacy** should be a part of the meaning of *zhi*, shown in (27):

(27) $[\![\text{Cl: zhi}]\!] = \lambda n \lambda y \lambda x. T(y, \text{animate objects})[RT(x, y)\ \&\ Unit(y)(x) = n]$

3.8 Summary

We can conclude that the classifier, as a quantifier word, is first selected by the numeral to indicate the number of the referent objects. For this step, the classifier only functions on the syntactic level. Meanwhile, the classifier contributes to the whole phrase's meaning by summing up the meanings of the classifier and the noun together to form a semantic intersection. There are two types of semantic relations expressed by classifiers. One is the taxonomic relation, in which the meanings of the classifier are entailed in the noun. The other is the modificational relation, which merges with the meaning of the noun and functions like a modifier. Both combine the semantics of the classifier and the noun.

In other words, the semantics of the classifier is first combined with the noun to form an intersection, and then this intersection applies to the numeral of the measure function between the realization relation R and the taxonomic relation T to denote the number of individual referents. This is indicated by the syntactic structure [$_{\text{NumP}}$ [Num CL]]. From §3.7, we can see that even the general unit classifiers denote lexical meanings. As we have seen that classifiers are sensitive to and can express lexical meanings, I argue that they are not merely function words but are open-class words. Below in section 4, I discuss the issue of closed- vs. open-class for classifiers and introduce a corpus study that supports their status as open-class.

4 The Relationship between the Classifier and the Noun

In this section I claim that classifiers are an open-class category, not a closed-class category, contra Li (2011) and Li (2013). From the following corpus study of Mandarin, the number of classifiers in Mandarin is around 200, making it doubtful that they are a closed category. I used Sogou Open News Corpus (https://www.sogou.com/labs/resource/cs.php) as the reference corpus to extract the data between numerals and nouns and get a rough collection of classifiers in Mandarin. There are nearly 6000 files, each with 800 words on average. With the Stanford Chinese NLP parser, we have collected 642 classifier words as the output. We cleaned the collection by filtering out the numbers, letters and other rarely used words. Overall, we found 200 valid classifiers.

This amount would be unusually large if classifiers were a closed category. Considering that we used is a tiny news corpus in Mandarin, we can predict that the number of actual valid classifiers is more than 200 in Mandarin. The overall number of Mandarin classifiers suggests that they are open-class, though they are standardly considered a closed-class category, as argued in Li (2013). Appendices A and B give a (non-exhaustive) list of taxonomic and modificational classifiers, respectively, with their semantic features and sample nouns that they take.

Other characteristics of classifiers argue against a closed-category status. First, they are often formally identical with (parts of) lexical nouns, which are open-class: bare nouns in Mandarin are

mostly compounds made of two words, and most classifiers can be used as one of the component stems of the compound nouns they modify (excepting unit and quantitative classifiers). For example, the classifier 'ben' in 'one CL-ben book' is the second stem of the bare noun 'shu-ben' (books) in Mandarin. Li 2013 mentions this in his book, but he splits the classifiers into different types and argues that classifiers are not nominal. I will use some of his examples below in (28-30).

(28) *tou* 'head' as noun and classifier

a. yì tóu niú
one CL.*tou* bull
'a bull'

b. yí gè tóu
one CL.*ge* head
'one head'

(29) *shan* 'fan' as noun and classifier

a. wǔ shàn mén
five CL.*shan* door
'five doors'

b. wǔ bǎ shàn
five CL.*ba* fan
'five fans'

(30) sān gè běn
three CL.*ge* book
'three exercise books'

I argue that 'one CL.*ge* head' (28b), 'five CL.*ba* fans' (29b), and 'three CL.*ge* exercise-books' (30) are acceptable in Mandarin, contrary to Li (2013). For example, (30) is the Mandarin expression of 'three exercise books', in which *ben* is the noun 'exercise book'. But, *ben* can be used as the classifier to modify 'book' as we have seen in (10a), in which *ben* means bound sheets of writings. This shows the classifiers can be used as (parts of) nouns. Moreover, there are semantic relationships between the two usages. The set of books (bound sheets of writings) contains the set of exercise books so the semantic content of *ben* as the classifier is contained in the semantic content of the noun. I conclude that the classifiers and the nouns in Mandarin partially overlap in their denotations, although this overlap is not complete.

5 Conclusion

In this paper, I have proposed a syntactic structure and semantic analysis for the classifier-noun construction in Mandarin with examples in order to show that classifiers express lexical meanings and that the general semantic contribution of the classifier is not just a measure function. Based on the syntactic structure I have given for classifiers, the classifier is first selected by the numeral to indicate the number of the referent individual objects, and then the classifier serves to complement the semantic content of the noun or as a semantic presupposition.

I have also argued that there are two types of semantic relations between the classifiers and the nouns. One is the taxonomic relation between the noun and the classifier, like unit classifiers *ben* and *liang*, while the other is the modificational function, such as the classifiers *wan* and *lun*, with an intersection relation. As a language that lacks number morphology, Mandarin uses classifiers not only to express the generic interpretation but also to contribute to the semantic content of nouns. Both the classifier and the noun express lexical meanings and denote objects in the world.

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Appendix A. Table of Taxonomic Classifiers in Mandarin.

Taxonomic Classifier	Sample Nouns Modified by Classifier	Features
本 ben	books, magazines, notebooks, journals	written materials with bound sheets
沓 da	paper, photos, receipts	thinner things such as paper that overlaps, indicating its whole
档 dang	shelves with horizontal boards	official cases
道 dao	rivers, rainbows, incisions, lightning, moonlight; walls, doors; orders, questions;	things used for blocking; things with the shape of long strips; orders or questions; verb uses similar to times
柄 bing	fans, spoons	handles of objects
步 bu	ways, moves (for chess game)	steps
餐 can	rice, meat (food of a meal)	meals
册 ce	books, magazines, journals	volume
处 chu	views, villas, villages, gardens	place, living place
顶 ding	hats/caps; the top of objects	tips
栋 dong	buildings	originally the main beam of a house
朵 duo	flowers	herbs
封 feng	letters, files; borders	closures
幅 fu	paintings, writings	the width of the ground; paintings; writings
副 fu	earrings, gloves	sets
杆 gan	guns, pens, flags	thin and long parts of objects
股 gu	ropes, spring water, blood	cylindrical objects
户 hu	tenements	windows
架 jia	planes, pianos, machines, grape trellises	objects with stands, machinery
间 jian	rooms, bedrooms, classrooms	smallest unit for measuring houses
节 jie	bamboo, roots of lotus, batteries, carriages	objects consisting of a long single part alone
句 ju	words, old or well-known sayings	sentences
棵 ke	trees, grass, cabbage, sunflowers, wheat seedlings	plants
块 kuai	biscuits, mirrors, handkerchiefs	lumpy objects
款 kuan	suits, costume	articles and items
粒 li	rice, sand, stones, teardrops	granular objects
辆 liang	cars, buses, bicycles, carriages	land transportation
枚 mei	coins, nails, chess pieces, buttons	small objects, equivalent to '*ge*'
亩 mu	acres of land or rice fields	land areas
幕 mu	acts of drama, operas, scenes	drama passages

Taxonomic Classifier	Sample Nouns Modified by Classifier	Features
匹 pi	pieces of cloth; horses	textiles such as cloth or silk (whole rolls); animals such as horses or mules, (individuals)
篇 pian	article; examination papers	paper and book pages
期 qi	engineering projects, courses	things with stages
扇 shan	doors, windows	originally doors made with bamboo
身 shen	clothes, body	things that fit the body
声 sheng	laughter, crying, shouts, groans	the sound of a person or thing
首 shou	poems, songs	originally describing complete poems or articles
双 shuang	hands, feet, shoulders, wings, shoes	pairs of things, human or animal limbs
丝 si	hair, traces	very little things
艘 sou	boats, freighters, warships	boats
所 suo	houses, hospitals, schools	(living) places, houses, hospitals
台 tai	printing machines, computers, recorders	machines, cars
堂 tang	mahogany furniture, cabinets	sets of furniture or tableware
趟 tang	trips	commuting, trips
套 tao	suits, costume, tableware	sets
条 tiao	line, necklace, towels, ties, straps	thin and long objects
味 wei	Chinese traditional medicine	single unit kind of Chinese medicine
席 xi	meals by tables, conversation	blankets for sitting
袭 xi	suits, outfits	clothes, especially for suits
项 xiang	systems, rules, regulations, agreements, claims	heads, types
页 ye	papers	a piece of paper in a bound book printed or written on one side
员 yuan	generals, veteran	persons/objects
盏 zhan	lamps, lanterns	originally the small cups for candles and oil lamps
枝 zhi	plum blossoms, apricot blossoms	flowers with leaves
株 zhu	willows, oaks	plants with roots
桩 zhuang	business, errands, worries, secrets, polls	things
幢 zhuang	skyscrapers, buildings	houses, buildings
宗 zong	transactions, payments, deals	cases
尊 zun	statues of gods or Buddha	statues
座 zuo	hills, islands, woods, mountains	large, heavy and solid objects

Appendix B. Table of Modificational Classifiers in Mandarin.

Modificational Classifier	Sample Nouns Modified by Classifier	Features
弯 wan	moon, brow	'bent'
滴 di	water, oil	'drop'
股 gu	rope, string, spring water, blood	originally meant 'rope'; now cylinder-shaped
口 kou	person, pig, well	'mouth'; represents population in household, draught animals, and wells
方 fang	handkerchief, monuments	square-shaped
段 duan	wood, time, way, rope	sections of long or strip-shaped things; measuring distances in time or space
包 bao	sugar, peanuts	'bag', 'pocket'
杯 bei	water, milk, tea	'glass', 'cup'
班 ban	students	'class'
笔 bi	money, income, debts, trade	'pen'; things related to money
层 ceng	floor, film, people	things that overlap, accumulate, or have layers
串 chuan	necklaces, keys, firecrackers	things with clusters or strings
袋 dai	any objects	things in bags or pockets
刀 dao	paper	'knife' = unit of paper (1 knife of paper = 100 pieces)
叠 die	clothes, paper	'pile'
堵 du	walls, cliffs	'to block'; walls
管 guan	water	'tube'
罐 guan	candy	'jar'
柜 gui	clothes	'cabinet'
锅 guo	meals, rice	'pan'
行 hang	people	'line', 'path'
盒 he	apples	'box'
壶 hu	wine	'kettle'
家 jia	inns, hotels, hospitals, schools, companies	'home'; buildings with occupants
截 jie	clothes	'section'
卷 juan	films, étamine fabric, wires	'roll'
列 lie	trains, troops, carriages	people/objects in horizontal lines
流 liu	experts, actors, athletes	level or category of people/objects
笼 long	birds, mice, rabbits	caged animals
路 lu	passers-by, people, merchandise	people/objects in vertical lines; level of people/objects

Modificational Classifier	Sample Nouns Modified by Classifier	Features
轮 lun	the Sun, the Moon, negotiations	‘round’; recurring actions
缕 lü	hair, sunshine	‘thread’
盘 pan	meals, vegetables	‘plate’
盆 pen	flowers	‘basin’
片 pian	leaves, petals, biscuits, bread slices	‘thin and flat’
瓶 ping	Coca-Cola	‘bottle’
圈 quan	children	‘circle’, ‘round-shaped’
束 shu	flowers, light	‘bundle’
通 tong	phones, orders, announcements	‘open’, ‘accessible’; measuring notices
桶 tong	water, wine	‘bucket’
头 tou	cow, ox, pig, elephant, goat	‘head’; livestock, usually large
碗 wan	rice, noodles	‘bowl’
线 xian	breaks, cracks, light, rainfall	‘string’, ‘line’, ‘thread’
箱 xiang	fruit	‘box’
张 zhang	paper, table, board	‘broad’, ‘flat’
阵 zhen	applause	processes, durative/lasting situations