Semantics of Quantifiers in Mandarin Chinese: 
\textit{Mei (每) ‘Every’ and Dou (都) ‘All’}

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Abstract—From a syntactic-semantic perspective, based on the number feature of subjects and predicates, we propose that: 1. \textit{Dou}, it is radically a maximal operator, while it is also a dependent distributor (or called “partial distributive operator”), which has to occur with plural individuality including \textit{mei}; 2. Compared to \textit{dou}, \textit{mei} is a near-independent distributive operator, in that with a quantity predicate, it can be an independent distributive operator, whereas with a property one, it requires other linguistic elements like \textit{dou} to create together the distributive effect; 3. The distributive effect can be achieved in diverse ways: by the sole entry \textit{mei}, by “\textit{mei} plus \textit{dou}”, and by the combination of \textit{dou} with its scoped nominals that possess “plural individuality”; 4. From the various ways of yielding distributive effect, a generalized rule is obtained: the plural feature and the individual feature, they contribute together to yield distributive effect.

Index Terms—semantics, quantifiers, Chinese, mei, dou, quantification

I. INTRODUCTION

The quantifiers in Mandarin Chinese \textit{mei (每) ‘every’ and dou (都) ‘all’} have been extensively studied with significant accomplishments (e.g., Choe, 1987; Liu, 1990; Cheng, 1995; Lin, 1998; Huang & Shi, 2013; Niu & Pan, 2015; Shen, 2015; Ruan, 2018; Huang, 2022). However, two issues arise: 1. Irrespective of whether it is the study of \textit{mei} or \textit{dou}, contradictory viewpoints are drawn upon despite the same theoretical framework applied to the studies (e.g., formal semantics); 2. Surprisingly similar research findings have emerged concerning the semantic properties of \textit{mei} and \textit{dou}.

Previous research on the semantics of \textit{mei} generally tends to three different viewpoints: universal quantifier (Huang, 1996, 2005), sum operator (Lin, 1998; Zhang & Pan, 2019), and distributive operator (Huang & Jiang, 2009; Luo, 2011).

A comparable threefold standpoint is also observed in the study of the semantics of \textit{dou}: universal quantifier (Lee, 1986; Pan, 2006; Jiang & Pan, 2013; Feng & Pan, 2018), sum operator (Huang, 1996, 2005; Yuan, 2005b), and distributive operator (Lin, 1998; Pan, 2000, 2006; Cheng, 2009).

The aforementioned two problems existed in previous studies not only necessitate further investigation into \textit{mei} and \textit{dou}, but also demonstrate the inherent limitations of formal logic analysis in natural languages. Therefore, this paper will explore the semantic properties of \textit{mei} and \textit{dou} and their relationship by adopting an approach of natural languages.

This paper is organized as follows: we first explore semantic functions of \textit{dou} in Section II, then we try to generalize the generative mechanism of distributive effect in Mandarin Chinese. In Section IV, we investigate semantics of \textit{mei}. In the last section, we summarize all of the above discussions.

II. DOU, DISTRIBUTIVE OPERATOR VS. MAXIMAL OPERATOR

A. Dou, a Dependent Distributor

According to Cheng (2009), it functions as two operators: a distributive and a maximal one. See \textit{dou} as a “distributive operator” in (1)\textsuperscript{1} and (2).

(1) a. 张三和马丽明天结婚。
Zhangsan he Mali mingtian jiehun.

Zhangsan and Mali tomorrow marry

‘Zhangsan and Mali will get married tomorrow.’

b. 张三和马丽明都结婚。
Zhangsan he Mali mingtian dou jiehun.

Zhangsan and Mali tomorrow DOU marry

\textsuperscript{1} Abbreviations used in the Chinese examples: 1: first person; 2: second person; 3: third person; BA: causative marker; CL: classifier; CL-General: General Classifier; CL\textsubscript{volume}: the classifier \textit{ben} ‘volume’; CL\textsubscript{bottle}: the classifier \textit{ping} ‘bottle’; CL\textsubscript{group}: the classifier \textit{zu} ‘group’; DE: associative particle; DEM: demonstrative; PASS: passive; PL: plural; PRF: perfective aspect; SFP: sentence final particle; SG: singular.
‘Zhangsan and Mali will both marry (someone else) tomorrow.’

(2)  
a. 我们 合用 一 个 厨房。  
Women heyong yi ge chufang.  
1PL share one CL-General kitchen  
‘We share a kitchen.’  

b. 我们 都 合用 一 个 厨房。  
Women dou heyong yi ge chufang.  
1PL DOU share one CL-General kitchen  
‘We each share a kitchen (with someone else).’

By means of symmetric predicates like jiehun ‘marry (each other)’, the distributive effect of dou is evidently demonstrated. In (1b), with dou, Zhangsan and Mali marry someone else, respectively. This contrasts with the husband-wife relationship between Zhangsan and Mali in (1a). The same is true of (2).

However, dou does not always play the role of distributor, as shown in (3), cited from Cheng (2009, p. 54).

(3)  
a. 他们 都 一起 来。  
Tamen dou yiqi lai.  
3PL DOU together come  
‘All of them came together.’  

b. 这 座 桥 都 倒-下来-了。  
Zheng zuo qiao dou dao-xialai-le.  
whole CL bridge DOU fall-down-SFP  
‘The whole bridge collapsed.’

The co-occurrence of dou with yiqi ‘together’ implies that their meanings are not contrastive. This tells us that dou in (3a) cannot be a distributive operator, just as Cheng argued that the translation ‘Each of them came together’ is not grammatical.

On the other hand, in (3b), unlike Cheng’s explanation, we would like to emphasize that dou is not a credible plural marker. In other words, dou does not license only plurals, since it can also receive singularity, such as zheng zuo qiao in (3b). We think that this phrase is referred to a singular entity rather than a plural one, which is however translated by Cheng (2009) as ‘pieces of the bridge’.

To see dou is not a plural marker, we provide the following cases in (4).

(4)  
a. 所有的 爱 都 给 你。  
Suoyou de ai dou gei ni.  
all DE love DOU give 2SG  
‘All love is given to you.’  

b. 一切 都 很 好。  
Yiqie dou hen hao.  
All DOU very good  
‘All is good.’ or ‘All are good.’

In (4a), ai ‘love’ which is scoped by dou is massive, while the two possible translations of the sentence in (4b) tell that dou can occur with singular references as well.

B. Dou, a Radical Maximal Operator

Based on the fact that dou can scope nominal singulants, we can infer that dou in (3b) does not function as a distributor. More precisely, we think dou is a maximal operator that gives a total interpretation to the set ‘zheng zuo qiao’ and involves all members of the set. But what happens to dou in this extreme case is that there is only one member in the set.

To see dou is maximal, we provide the following cases in (5).

(5)  
a. 学生-们 去 学校 了。  
Xuesheng-men qu xuexiao le.  
student-PL go school SFP  
‘The students have gone to school.’  

b. 学生-们 都 去 学校 了。  
Xuesheng-men dou qu xuexiao le.  

The students all have gone to school.

In (5a), the number of the students do not have to be strictly maximal, most of them have gone to school is enough, whereas in (5b), with the presence of dou, the event involves every student of the set ‘Xuesheng-men’. This semantic contrast demonstrates that dou has maximal function.

To sum up, we partially concur with Cheng (2009) in claiming that dou functions not only as a maximal operator, but also as a distributive operator. Furthermore, we propose that dou’s maximality is primary (radical) and obligatory, whereas its distributivity is secondary and optional. This is supported by our findings that dou is neither a sufficient nor a necessary condition for generating distributive effect. This point is further confirmed by the fact that the distributive effect can be achieved in diverse ways: 1. By the combination of dou with its scoped nominals that possess “plural individuality”\(^2\); 2. By applying “mei plus dou”, as proposed by Cheng (2009)\(^3\). 3. By the standalone use of mei. The first two ways above demonstrate that dou needs other linguistic elements to generate the distributive effect. Therefore, dou is not an independent distributive operator, i.e. it is a dependent distributor (or called “partial distributive operator”).

### III. GENERATIVE MECHANISM OF DISTRIBUTIVE EFFECT

In this section, we will analyze the three aforementioned ways to achieve distributive effect, with the intention of: 1. Demonstrating that the fundamental semantics of dou is not distributive; 2. Exploring the correlation between mei and dou. Initially, we investigate “plural and individual nominal+dou”, then mei, and in the end “mei plus dou”.

#### A. “Plural and Individual Nominal + Dou” & “Mei”

See the examples in (6) and (7) for “plural and individual nominal+dou” and mei, respectively.

(6)  
\begin{align*}  
\text{a. } & \text{Tamen you san ben shu.} & \text{They have three books.} \\
\text{b. } & \text{Tamen dou you san ben shu.} & \text{Each of them has three books.} \\
\text{c. } & \text{Zhe san ge ren he le wu ping shui.} & \text{These three people have drunk five bottles of water.} \\
\text{d. } & \text{Zhe san ge ren dou he le wu ping shui.} & \text{Each of these three people has drunk five bottles of water.}
\end{align*}

(7)  
\begin{align*}  
\text{a. } & \text{Mei ge xuesheng you san ben shu.} & \text{Every student has three books.} \\
\text{b. } & \text{Mei ge xuesheng dou you san ben shu.} & \text{Every student has three books.}
\end{align*}

In (6), the nominals tousen ‘they’ and zhe san ge ren ‘these three persons’ both refer to plural entities, i.e. objects with individuality and plurality. However, the minimal pair (6a) and (6b) offer different quantificational information. This is due to whether dou occurs. With the presence of dou, tousen ‘they’ is distributed, so every person among them has his own three books. The same account can cover the contrast between (6c) and (6d).

In brief, a nominal with plural individuality can produce distributive effect if it occurs with dou.

In (7) where mei occurs, there is no interpretative contrast, regardless of whether dou occurs. In both cases, the

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\(^2\) With respect to “plural individuality”, it means referents that have not only the feature of semantic individuality but also that of semantic plurality. This rules out referents like: 1. scissors in English, having [-semantic plurality, +semantic individuality]; 2. water in English, having [-semantic plurality, -semantic individuality].

\(^3\) Cheng (2009) proposed that the distributive effect does not attribute to a single-handed dou, instead, it is created by mei and dou together.
members of xuesheng ‘student’ set are distributed. This fact shows that mei can be a distributor without dou. In this sense, mei is an independent distributive operator. In addition, the contrast between (7a) and (7b), that is, dou is present or absent, demonstrates that dou is not a necessary element to produce distributivity.

Generally speaking, the sole entry mei can yield the distributive effect.

B. “Mei + Dou”

Now let’s focus on “mei plus dou”, as seen in (8).

(8) a. *每 个 学生 笑 了。
   Mei ge xuesheng xiao le.
   Intended: ‘Every student laughed.’

   b. 每 个 学生 都 笑 了。
   Mei ge xuesheng dou xiao le.
   ‘Every student laughed’ or ‘Every one of the students laughed.’

In (8), the illegal status of (8a) is caused by the absence of dou. It seems that mei must co-occur with dou, this appears to be contradictory to the fact shown in (7) where mei does not need to occur with dou together.

For this contradiction, we propose the following reason: it is correlated to the diverse nature of predicates. The predicate in (7) is quantificational, while the one in (8) is qualificational (it regards some property, not quantity).

This quantity-property contrast between predicates is clearly seen in cases like (9).

(9) a. 他们 笑 了。
   Tamen xiao le.
   ‘They laughed.’

   b. 他们 都 笑 了。
   Tamen dou xiao le.
   ‘They all laughed.’

   c. 他们 有 三 本 书。
   Tamen you san ben shu.
   ‘They have three books.’

   d. 他们 都 有 三 本 书。
   Tamen dou you san ben shu.
   ‘Each of them has three books.’

In (9), the predicates of (9a) and (9b) are both a property xiao ‘laugh’, while those of (9c) and (9d) both regard a quantity you san ben shu ‘have three books’. With the quantity predicate there is a different interpretation between (9c) and (9d), whereas with the property predicate (9a) and (9b) almost have the same meaning.

More precisely, for (9d), tamen ‘they’ and dou product together the distributive effect. The nominal tamen ‘they’ is distributed, each member that belongs to the set tamen has three books. If the set has two members, they have six books in total. The accumulation is visible due to the quantificational predicate. However, for (9b), following the same way, the accumulation is not directly sensed, since the relevant predicate is qualificational: xiao ‘laugh’ plus xiao ‘laugh’ is still xiao ‘laugh’.

Returning to the previous “mei plus dou” question, i.e. why there is a contrast of grammaticality between (7a) and (8a), our explanation is that the distributive function of mei is weakened by a property predicate. For cases like (8) where there is a property predicate, mei’s distributive function is weakened, and it needs the help of dou, which can contribute to add distributive effect.

As for cases like (7), the optional presence of dou attributes to the nature of its predicate: a quantity one, which makes the distributive effect visible. In this situation, a sole mei is enough to finish the distributive operation. To justify our proposal above, we present a selection of examples in (10) drawn from Cheng (2009, pp. 60-62).

(10) a. 每 (一) 个 学生 *(都) 来 了。
   Mei (yi) ge xuesheng *(dou) lai le.
   THEO
‘Every student came.’

b. 每 (一) 个 学生 * (都) 看 了 那 本书。
   Mei (yi) ge xuesheng * (dou) kan le nei ben shu.
   ‘Every student read that book.’

c. 每 (一) 个 厨师 (都) 做 一 道 菜。
   Mei (yi) ge chushi (dou) zuo yi dao cai.
   ‘Every chef makes a dish.’

d. 每 (一) 个 厨师 * (都) 做 那 道 菜。
   Mei (yi) ge chushi * (dou) zuo nei dao cai.
   ‘Every chef makes that dish.’

As shown in (10), lai ‘come’ in (10a) is a standard property predicate, while kan nei ben shu ‘read that book’ in (10b) and zuo nei dao cai ‘make that dish’ in (10d), seem, at first glance, a quantity one. But if we think carefully, we will discover that they both regard a definite referent. Therefore, this type of predicate indicates a property as well, just like predicates such as kan shu ‘read books’ does. On the other hand, zuo yi dao cai ‘make a dish’ in (10c) belongs to quantity predicates.

To sum up, we argue that there are three ways to yield distributive effect. One is using only a word mei (dou is optional), if the predicate of a clause is a quantity one. Another is combining mei and dou, if the predicate of a clause is a property one. The last one is through the pattern “plural and individual nominal+dou”.

IV. MEI, A NEAR-INDEPENDENT DISTRIBUTOR

As we mentioned before, mei can be an autonomous distributor if the predicate of a clause is a quantity one. Now let’s explain why it is so.

First, we argue that mei is an individualizing operator. This proposal is different from the standpoint in Cheng (2009) where mei is thought of as universal force. The individualizing function of mei is due to facts illustrated in (11).

(11)  a. 每 三 本 书
      Mei san ben shu
      ‘every three books’

b. 每 五 瓶 水
   Mei wu ping shui
   ‘every five bottles of water’

From (11a), we can see that, mei scopes over the whole numeral expression san ben shu ‘three books’. In this expression, the CL ben ‘volume’ modifies only the noun shu ‘book’, and it individualizes this noun. In addition, the whole phrase mei san ben shu ‘every three books’ has an individualizing meaning.

These two points imply that it is not the CL ben ‘volume’ that contributes to the individuality of the whole phrase mei san ben shu ‘every three books’, but the sole mei does, as shown by the dotted circles in (11). As a consequence, we can say that mei is an individual operator. The same is true of (11b).

Second, we claim that mei is a pluralizing operator. This is supported by Lin’s (1998) viewpoint that nouns phrases with mei is a plurality, as shown in (12) and (13).

(12)  a. 我们 每 个 人
       wo mei ge ren
       1SG MEI CL-General person
       ‘all of us’

b. * 我 每 个 人
    * wo mei ge ren
    1SG MEI CL-General person

(12b) is illegal in that the first and singular personal pronoun wo ‘I’ cannot be co-indexed with mei ge ren ‘everyone’, whereas (12a) is acceptable due to the plural referent of women ‘we’, which regards two persons at least.
(13)  a. 我有三本书，每本都很好。  
   Wo you san ben shu, mei ben dou hen hao.  
   ISG have three CL_book MEI CL_book DOU very good  
   ‘I have three books, each of them is good.’

      b. *我有一本书，每本都很好。  
      *Wo you yi ben shu, mei ben dou hen hao.  
      ISG have one CL_book MEI CL_book DOU very good  
      ‘I have one book, each of them is good.’

      c. *我吃了冰淇淋，每个人都很开心。  
      *Wo chi le bingqilin, mei ge ren dou hao kaixin.  
      ISG eat-PRF ice-cream MEI CL-General person DOU very good  
      ‘I have eaten ice-cream, everyone is happy.’

      d. 我们吃了冰淇淋，每个人都很开心。  
      Women chi le bingqilin, mei ge ren dou hao kaixin.  
      1PPL eat-PRF ice-cream MEI CL-General person DOU very good  
      ‘We have eaten ice-cream, everyone is happy.’

The contrast between (13a) and (13b) is caused by the opposite number of the quantifying expressions: in (13a) san ‘three’ explicitly indicates the plural state of shu ‘book’, so mei is legal; whereas in (13b) yi ‘one’ expresses the nominal singularity, thereby, mei is illegal.

Furthermore, the contrast between (13c) and (13d) is provoked by the contrary number of pronoun: in these two examples, we presume that pronouns wo ‘I’ and women ‘we’ in the first clause are co-indexed with mei ge ren in the second clause, respectively. Under this premise, the ungrammatical status of (13c), i.e. wo ‘I’ and mei ge ren ‘every person’ fail to have an anaphoric relationship, tells us that mei has to be a plural marker.

In brief, we propose that mei has pluralizing function. This is further supported by the following minimal pair, offered by Lin (1998, p. 236).

(14)  a. 每一组小孩都画了一张画。  
   Mei yi zu xiaohai dou hua le yi zhang hua.  
   MEI one CL_child DOU draw PRF one CL_picture  
   ‘Every group of children drew one picture.’

      b. 那一组小孩都画了一张画。  
      Nei yi zu xiaohai dou hua le yi zhang hua.  
      that one CL_child DOU draw PRF one CL_picture  
      ‘That group of children all drew a picture’

In (14a) zu ‘group’ is distributed, whereas in (14b) xiaohai ‘child(ren)’ is distributed. This contrast results from the absence of mei in (14b). As mentioned before, mei gives plural feature to its local (nearest) elements. In (14a), it gives this feature to the CL zu ‘group’, instead of the nominal xiaohai ‘child(ren)’.

In contrast, in (14b), mei is not present, so zu ‘group’ does not get the opportunity to demonstrate plural feature. In addition, nei yi zu ‘that group’ denotes a singular referent. As a consequence, dou is forced to turn to other possible plural individuality, that is, xiaohai ‘child(ren)’, a bare noun with RB (referential boundary) that can offer the feature required by dou, i.e. plurality.

In order to explore mei in a deeper way, it needs to generalize the conditions of distributive operation.

If we change the number of the expression that dou scopes in (14b), dou will help to distribute zu ‘group’ again, instead of xiaohai ‘child(ren)’, as illustrated in (15). The contrast between (14b) and (15) implies that to finish the distributive operation, the object to be distributed must have plurality feature.

(15) 那三组小孩都画了一张画。  
Nei san zu xiaohai dou hua le yi zhang hua.  
that three CL_group child DOU draw PRF one CL_picture  
‘These three groups of children all drew a picture’

Based on the above conclusion that plural feature is indispensable to realize distributive operation, we wonder

\[\text{The RB notion has been proposed by Ruan (2018, p. 79).}\]
whether individuality feature is also indispensable. To seek the answer, we would like to analyze examples in (16).

(16) a. 桌子上 全部的水都被擦干了。
   *Zhuozi-shang quanbu de shui dou bei cagan-le.*
   table-on all DE water DOU PASS wipe-up-PRF
   ‘All the water on the table was wiped up.’

b. 我买了三瓶水，我把全部的水都喝了。
   *Wo mai-le san ping shui, wo ba quanbu de shui dou he-le.*
   1SG buy-PRF three CL_bottle water 1SG BA all DE water DOU drink-PRF
   ‘I bought three bottles of water, all of them were drunk by me.’

From the contrast between (16a) and (16b) in terms of translations, we can say that *quanbu de shui* ‘all the water’ in (16a) is not distributed, whereas that in (16b) is. This is because this expression in (16b) refers to three bottles of water, which are three individual entities; while that in (16a) does not refer to individualized objects.

Hence, we argue that like plural feature, individual feature is also necessary to realize distributive operation. In addition, we argue that these two features contribute together to yield distributive effect.

To sum up, we propose that occurred with a quantity predicate, *mei* can be an independent distributive operator, whereas with a property one, it requires other linguistic elements like *dou* to create together the distributive effect. In this sense, *mei* can be seen as a near-independent distributive operator, in comparison to *dou*.

V. CONCLUSION

Starting from natural language facts, we explored semantic properties of *mei* and *dou* from a syntactic-semantic perspective. We found that: 1. *Dou*, it is radically a maximal operator, while it is also a dependent distributor (or called “partial distributive operator”), which has to occur with plural individuality including *mei*; 2. Compared to *dou*, *mei* is a near-independent distributive operator, in that with a quantity predicate, *mei* can be an independent distributive operator, whereas with a property one, it requires other linguistic elements like *dou* to create together the distributive effect; 3. The distributive effect can be achieved in diverse ways: by the sole entry *mei*, by “*mei* plus *dou*”, and by the combination of *dou* with its scoped nominals that possess “plural individuality”. These diverse ways of yielding distributive effect can be reduced to a generalized rule: the plural feature and the individual feature, they contribute together to yield distributive effect.

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