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MEI AND *DOU* IN CHINESE: A TALE OF TWO QUANTIFIERS*

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ABSTRACT

This study addresses two outstanding puzzles about the two well-known quantifiers *mei* and *dou* in Chinese: (i) the indefinite/definite asymmetry when *mei* leads the subject NP: *dou* is not needed when there is an indefinite or a reflexive object within the scope of *mei* and (ii) the subject/object asymmetry: when *mei* leads the subject NP, its distribution is restricted, depending on the type of the objects, and, by contrast, when it leads the object NP, its distribution is much freer. We propose a novel account for these puzzles. We argue that (i) the indefinite/definite asymmetry can be explained away if we assume that *mei* is a distributive quantifier with a portmanteau semantic structure, i.e., that it is a standard universal quantifier plus a matching function; (ii) *mei* can be domain-shifted into a distributive determiner to satisfy interpretability, and this explains the subject/object asymmetry and (iii) this domain-shifting is regulated by the Principle of Economy (cf. Reinhart (2006)), which is a last resort to satisfy interpretability.

Key words: distributive quantification, determiners, quantifiers, *mei*, *dou*

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1. INTRODUCTION

It is well-known that there is a co-occurrence constraint between *mei* and *dou* in Chinese, that is, whenever *mei* occurs, *dou* does also. *mei* is traditionally treated as a counterpart of *every* and *dou* as a counterpart of *all*/*each*.[1] English *every*, however, is not subject to this co-occurrence constraint. The following example (1) illustrates the co-occurrence between *mei* and *dou*, and (2) shows that no such constraint exists in English:

(1) Mei-ge ren *(dou) lai le.
MEI-CL person DOU come PERF
'Every man came.'
(2) Every man (*each/*all) came.

However, some recent studies have pointed out that this co-occurrence constraint is by no means absolute. Huang (1996) observes that when the object is an indefinite or a reflexive, *mei* can occur alone. The following two examples under (3) are judged to mean the same:

(3) a. Xi-li de mei-ge jiaoshou dijiao-le yi-fen
dept-LOC DE MEI-CL professor submit-PERF one-CL
jingfei shenqing.
grant application
'Every professor in the department submitted a grant application.'
b. Xi-li de jiaoshou dou dijiao-le yi-fen
dept-LOC DE professor DOU submit-PERF one-CL
jingfei shenqing.
grant application
'The professors in the department each submitted a grant application'
(4) $\forall x$ (professor (x) $\rightarrow \exists y$ (grant application (y) & x submit y))
(= (3a-b))

[1] Traditionally, *mei* is glossed as *every* while *dou* as *all*. For the ease of exposition, we simply gloss *mei* and *dou* as MEI and DOU, respectively in this paper.

At first glance, *mei* is like English *every* while *dou* is like English *each*, since *mei* occupies a determiner (in syntactic sense) position while *dou* an adverbial position. But there is evidence indicating that it is too superficial to only consider this point of similarity. *Dou* does not seem to always like *each*: while English *each* is incompatible with collective predicates (i.e.**,** VPs that are used to predicate about group actions), *dou* is happy with them (cf. Lin 1998):

(5) * The students each meet at noon.
(6) Tongxue -men dou zhongwu jianmian.
students-PL DOU at noon meet
'Students all met at noon.'

The best translation of (6) in English is *students all met at noon*, which suggests that *dou* sides with *all*.

However, this link is also problematic. In English, neither *all* nor *each* is compatible with *every*, as shown by (2) above.

It seems that Chinese possesses two quantifiers which have universal quantificational force. The standard wisdom of Generalized Quantifier Theory (GQT) tells us that GQs like *every man* (henceforth QPs) denote a set of sets, and that determiners like *every* (henceforth quantifiers) denote a function from properties to properties to truth values. Usually, a quantifier has two arguments. Take '[[Q NP] VP]' for example, here NP contributes the first argument, and VP contributes the second argument. However, this wisdom says little about the compositionality of the form '[Q1 NP] [Q2 VP]', as demonstrated by (1). (1) contains two quantifiers, *mei* and *dou*, and both have universal quantificational force of their own, as shown by examples (3a) and (3b), respectively. Could these two quantifiers make the same semantic contribution?

Matthewson (2001) has made a very interesting suggestion. By drawing evidence from St'át'imcets (an Indian language spoken in North America), she argues that the creation of a generalized quantifier from an NP predicate always proceeds in two steps rather than one. The first step is the creation of a DP. That is to say, [Q1 NP] [Q2 VP] must be reanalysed as [[Q2 [$_{DP}$ Q1 NP]] [VP]], while one of the Qs is a

determiner. Here we follow the standard GQT distinction between quantifiers and determiners. A quantifier, type-typologically, is of <et, <et, t>> and [Q NP] is quantificational. A quantifier operates on properties and returns a function from properties to truth values. A determiner is always of type <et, e>, and [Det NP] is referential (i.e., of type *e*). A determiner operates on properties but returns an individual that has the properties denoted by its argument. This account fits Chinese *mei* and *dou* neatly. Matthewson thinks that her suggestion also finds evidence from Chinese, citing the co-occurrence constraint between *mei* and *dou* (she attributes the observation to Lisa Cheng (p.c.) and Lin (1998)) (Matthewson 2001: 178-179):

(7) [QP [$_{DP}$ mei-ge jiaoshou] Dou] [VP]

In (7), '*mei* NP' contributes the DP, which forms the first argument of the quantifier *dou*. The compositionality problem is circumvented in this account. However, this account has a problem with example (3), which shows that *mei* can be analyzed as a quantifier and that it has quantificational force of its own.

The above discussion presents one puzzle concerning *mei* and *dou*: that of indefinite/definite asymmetry. *dou* is not needed only when there is an indefinite object or a reflexive within the scope of *mei* (Huang 1996:35). The following sentence containing a definite object, for example, is odd without *dou*:

(8) * Mei-ge xuesheng chang-le zhe-shou ge.
MEI-CL student sing-PERF DEM-CL song
'Every student sang this song.'

English does not have such indefinite/definite asymmetry (cf. *every man loves a women* vs. *everyone man loves [the woman you met yesterday]*). This renders the Chinese *mei* enigmatic if we analyze it on a par with English *every*. In addition to this conundrum, there is another one: that of subject/object asymmetry. While the distribution of *mei* is highly restricted in subject positions, depending on the type of the objects that it scopes over, its occurrence in object positions is

considerably freer. In short, *mei* could occur in object positions with less restriction, regardless of the type of the subjects. Consider:

(9) You yi-ge xuesheng du-le mei-ben guanyu hanyu
have one-CL student read-PERF MEI-CL on Chinese
lianghua de boshi lunwen.
quantification DE PhD thesis
'A student read every PhD thesis on Chinese quantification.'
(a) ∃>∀ ; (b) *∀>∃

The QP headed by *mei* in (9) does not allow a wider scope interpretation with respect to the subject indefinite QP. By contrast, in English, an inverse reading sometimes is available, if not without controversy (cf. May 1977, 1985; Reinhart 1997; among others). For instance, while the following (10) is judged to be (marginally) acceptable in English, its exact counterpart in Chinese is judged to be pragmatically impossible and thus unacceptable:

(10) A (different) flag stands in front of every building.
(11) * Yi-mian qizhi lizai mei-zuo jianzhuwu qianmian.
one-CL flag stand MEI-CL building front

If (10) is acceptable, the most natural reading for it is that for each building, there is a (different) flag standing in front of it. These two asymmetries cast doubt on Matthewson's suggestion, for all its plausibility.

Closer examination indicates the following generalization about the interactions between *mei* and *dou* (NA stands for non-available). This generalization constitutes the primary data to be explained:

Table 1. The distribution and scopal interpretation of *mei* and *dou*

EVERY-type expressions	Chinese	English	Scope in Chinese
[MEI NP] [$_{VP}$V [$_{NP}$ indefinite NP]]	√	√	∀>∃; *∃>∀
[MEI NP] [$_{VP}$V [$_{NP}$ definite NP]]	*	√	
[MEI NP] [$_{VP}$ intransitive-VP]	*/??	√	
[MEI NP] [DOU [$_{VP}$ intransitive-VP]]	√	NA	∀>∃
[MEI NP] [DOU [$_{VP}$V [$_{NP}$ indefinite NP]]]	√	NA	∀>∃; ? ∃>∀
[NP] [$_{VP}$ [V [MEI NP]]]	√	√	∃>∀; * ∀>∃

We address the following problems and attempt to provide a unified account for them in this paper:

(a) Why is *dou* optional when the object that is within the scope of *mei* is an indefinite?
(b) Why is there a subject/object asymmetry in the distribution of *mei*?
(c) How can the *compositionality problem* which arises when when *mei* and *dou* co-occur be solved?

This study is structured as follows. Section 2 evaluates several existing accounts and points out their empirical difficulties. Section 3 presents our own proposal. Section 4 looks at the indefinite/definite asymmetry in the light of the present proposal. More supporting evidence is provided in Section 5. Section 6 discusses the subject/object asymmetry. Section 7 considers the co-occurrence (constraint) between *mei* and *dou* by means of type-shifting. Some residual issues and the variations between Chinese and English are discussed in Section 8.

2. WHERE WE HAVE BEEN: THE EXISTING ACCOUNTS

2.1 Determiner *mei*, Quantifier *dou*

Lin (1998) looks at the facts of the co-occurrence of *mei* and *dou*. By arguing that *dou* has a strict plurality requirement, that is, *dou* can only quantify a plural domain that is located to its left side (cf. also Lee (1986), Cheng (1996)), he claims that in the construction '*mei* NP *dou* VP', '*mei* NP' also denotes a plural individual. He provides two pieces of evidence to show that '*mei* NP' stands for a plural individual: (i) '*mei* NP' can occur with a reciprocal or a collective predicate, which indicates that *mei* is not inherently distributive and (ii) '*mei* NP' sometimes has an intermediate reading, which is the same as the reading that a plural NP sometime has (cf. Gillon (1987), Schwarzschild (1996), among others).

A reciprocal predicate or collective predicate is always used to predicate a plural individual. The fact that a reciprocal predicate or a collective predicate can occur with *mei* indicates that '*mei* NP' is also plural and not inherently distributive. Consider the following examples (Lin's (63) and (64)):

(12) a. Mei-ge ren dou huxiang qinwen-le yixia.
MEI-CL person DOU reciprocally kiss-PERF one-time
'Everyone kissed each other.'

b. Zhe-ci kaoshi, mei-ge tongxue dou fan-le yi-ge
DEM-CL exam, MEI-CL classmate DOU make-PERF one-CL
xiangtong de cuowu.
same DE mistake
'As for the exam this time, every student made a mistake of the same kind.'

Sometimes, '*mei* NP' also displays some intermediate readings, a reading observed to be available for plural NP. Thus, according to Lin, the following sentence is true in a situation where some linguists only have articles which are coauthored. This interpretation is available only when '*mei* NP' is plural:

(13) Zhe-li de mei-ge yuyanxuejia dou zai qikan-shang
here DE MEI-CL linguist DOU in journal-LOC
fabiao-guo wenzhang.
publish-PERF article
'Every linguist here has articles published in a journal.'
(Lin 1998, Example (65))

If '*mei* NP' denotes a plurality, the problem of how to account for the co-occurrence between *mei* and *dou* is partially resolved. Lin claims that *mei* denotes a function that takes a predicate of type <e, t> as its argument and returns the maximal collection of the individuals denoted by the predicate. In other words, *mei* semantically functions as the definite article 'the'. Type-logically, *mei* is of type <et, e> rather than <et, <et, t>>. In our words, it is a determiner rather than a quantifier.

(14) Lin's Solution (LS) (p. 238)**:**
[[MEI-(CL)]] = that function f such that for all $P \in D_{<e,t>}$, $f(P) = \cup[[P]]$
[[DOU]] = $\lambda P \lambda X \forall y[y \subseteq X \wedge y \in \|Cov\| \rightarrow P(y)]$, where $P \in D_{<e,t>}$

A common noun is of type <e, t>, thus it can combine with *mei*. This operation yields a maximal individual that falls in the extension of the common noun. *mei-ge jiaoshou* ('every professor'), e.g., denotes the maximal individual that has the property of being professors. That is, '*mei*-CL NP' always denotes a plural individual, which forms the distributable domain for *dou* and is distributively quantified by *dou*. The following example (15) thus receives the semantic representation as shown in (16):

(15) Mei-ge jiaoshou dou dijiao-le yi-fen jingfei shenqing.
MEI-CL professor DOU submit-PERF one-CL grant application
Lit.: 'Every professor *dou* submit a grant application.'
(16) [[15]] =1 iff $\forall x$ ($x \in \cup$ professors & $x \in$ [[Cov]] $\rightarrow$
x submitted a grant application)

In this account, the compositionality problem between *mei* and *dou* doesn't arise. Since *mei* is a determiner and *dou* is a quantifier,

compositionality follows naturally (cf. Matthewson's suggestion). However, despite its obvious success, this analysis has its own problems. It first fails the indefinite/definite puzzle. It says little about why *dou* is optional when the object that *mei* scopes over is an indefinite. In other words, it ignores the fact that *mei* can also independently function as a quantifier rather than a determiner. Also, Lin's claim that *mei* is not inherently distributive suffers from empirical problems.

In a situation where the president meets the student representatives one by one, the following sentence (17a) is always judged to be preferred to (17b).This situation specifies a distributive reading.

(17) a. Xiaozhang jiejian-le mei-ge xuesheng daibiao.
president meet-PERF MEI-CL student representative
'The president met every student representative.'
b. Xiaozhang jiejian-le quanbu xuesheng diaobiao
president meet-PERF all student representative
'The president met all the student representatives.'

(17a) contains *mei*, and (17b) contains an element that denotes a totality. Although the difference between (17a) and (17b) does not result in a big truth conditional differencehere, the informants' judgment based on degrees of preference indicates that '*mei* NP' is distributive. Even if '*mei*' is a determiner, it must be a special one, that is, a distributive determiner. It should be noted that distributivity is not inherently incompatible with the intermediate readings (cf. Link (1983), Gillon and Schwarzschild), because, distributivity can operate on the 'covers' of a set, not necessarily only on the atoms of a set.

Another problem with this analysis is the existence of the co-occurrence constraint between *mei* and *dou.* In principle, a plural-individual-denoting NP can stand alone (without *dou*). If '*mei*-CL NP' denotes a plural individual, it has to be explained why this plural individual is unlike ordinary individuals and always requires the company of *dou*.

Concluding, Lin's solution only provides a partial solution to the puzzles.

2.2 Quantifier *mei*, Sum Operator *dou*

Huang (1996) notices that when there is an indefinite or a reflexive object NP, *dou* becomes optional. Consider the contrast between (18a) and (18b) below:

(18) a. Mei-ge xuesheng chang-le yi-shou ge.
MEI-CL student sing-PERF one-CL song
'Every student sang a song.
b. * Mei-ge xuesheng chang-le zhe-shou ge.
MEI-CL student sing-PERF DEM-CL song
'Every student sang this song.'

(18a) has an indefinite object within the scope of *mei* and is acceptable without *dou*. (18b), by contrast, has a definite object and is unacceptable without *dou*. Why this contrast? Huang proposes:

(19) Huang's solution (HS)):
mei is a Skolemized universal quantifier and it requires a lexically overt variable within its scope to license this Skolemized quantification;
dou is a sum operator over events.

(20) 'EVERY (P, *f*(P)) is true iff for every P'⊆P, P' is a subset of *f*(P'), where *f*(P) is constructed from P by a total skolem function (p. 25).
'{x: DOU Pred (x)} = {x: AT(Pred(x, e)) and DOU(e, Pred)} where DOU (e, Pred) is true iff e is an event of minimum size consistent with the semantics of Pred (p. 39)

According to Huang, (18a) is acceptable because the object that falls within the scope of *mei* is a lexically introduced indefinite, and this satisfies (20). (18b) contains a definite object, which blatantly violates (20) and results in oddness. Huang thus provides a straightforward explanation for the contrast between (18a) and (18b), i.e., a solution to the indefinite/definite asymmetry puzzle.

Huang also discusses cases when *mei* and *dou* co-occur. She argues that *dou* always introduces an event argument into the semantic

representation (as tense does in English). And *dou* is a sum operator over events. So, *mei* and *dou* operate in different domains. When *dou* is present, some extra event quantification is being added to the semantic representation.[2]

It is easy to see that Huang's analysis leaves the puzzle of subject-object asymmetry unexplained. '*mei*-CL NP' could appear in object positions irrespective of the absence/presence of *dou* or the type of the subject NPs. The naturalness of '*mei*-CL NP' in object positions is unexpected under Huang's analysis: in (21) below, the universally quantified object cannot scope over the subject, and how *mei* is licensed becomes a mystery. The relevant example (9) is repeated as (21) below for illustration:

(21) You yi-ge xuesheng du-le mei-ben guanyu hanyu
have one-CL student read-PERF MEI-CL on Chinese
lianghua de boshi lunwen.
quantification DE PhD thesis
'A student read every PhD thesis on Chinese quantification.'
(a) ∃>∀ ; (b) *∀>∃

Huang's strategy is to dismiss these examples, as she claims, 'it is not as natural to use a *mei* noun phrase in the post-verbal position in Chinese as it is to use an *every* noun phrase in such a position in English'. (Huang 1996: 52-54). However, as Lin and many others observe, '*mei*-CL NP' is fine to occur in post-verbal object positions. We think that the failure to account for the subject/object asymmetry presents a

[2] Huang does not make a distinction between states and events (but please refer to Kratzer 1995 for more discussion of this distinction). Presumably, her 'event arguments' cover states given the following observation, as pointed out by one reviewer:

(i) Tamen dou shi Ouzhou-ren.
they DOU be Europeans
'They are all Europeans.'

The only requirement for 'DOU Pred', as claimed by Huang, is that it is associated with a plural event argument which is a sum of minimum events (Huang: 72). We thank the reviewer for drawing our attention to this point.

real challenge to Huang's analysis.

There is another problem with this analysis. It is unclear why the indefinite event variable cannot license the Skolemized universal quantifier *mei*. The following (22a) is odd, even if we suppose that there is an event variable in the scope of the universal quantifier:

(22) a. * Mei-ge xuesheng lai-le.
MEI-CL student come-PERF
b. $\forall x$ ($x \in$ **student** $\rightarrow \exists e$ (**came** (x, e) & *f*(x) =e))

To summarize: Huang provides a solution to the indefinite/definite asymmetry puzzle, but fails to find one to the subject/object asymmetry puzzle.

2.3 Universal *mei*, Distributive *dou*

Unlike the aforementioned studies, Yang (2001) proposes that *mei* is still a universal quantifier, but that this quantifier only contributes the universal quantificational force. *Mei* then is said to denote a function from a property P to a generalized quantifier introducing the *maximal* sum individual X such that its atomic part each has the property P and the sum X is contained in the set of Q-denoting individuals (Yang 2001: 93)

(23) Yang's Solution (YS)
$[\![mei]\!] = \lambda P \lambda Q (\exists X (\forall x (x \in X \leftrightarrow P(x)) \wedge Q(X)))$

When *mei* and *dou* co-occur, *dou* contributes distributivity. Moreover, Yang argues that the scope is assigned by *dou* instead of by the superficial syntactic structure. The following two sentences thus have different interpretations:

(24) a. Mei-yi-ben shu dou you yi-ge ren mai-le.
MEI-one-CL book DOU have ONE-CL person buy-PERF
b. Mei-yi-ben shu you yi-ge ren dou mai-le.
MEI-one-CL book have ONE-CL person DOU buy-PERF

(24a) and (24b) receive distinct semantic representations, as shown by (25) and (26) below, respectively:

(25) a. [[you yi-ge ren mai-le t]] = λx∃v(**man** (v) & **bought** (x)(v))
b. [[dou]] =λP(∀x(x∈ X→P(x))
c. [[dou you yi-ge ren mai-le t]] =∀x(x∈ X→∃v(**man**(v) & **bought** (x)(v))
d. Predicate Abstraction (c): λX∀x(x∈ X→∃v(**man**(v) & **bought** (x)(v))
e. [[mei-yi-ben shu]] = λQ(∃X(∀x(x∈ X↔(**book**(x) & **CL**(x)=1)) ∧ Q(X))
f. [[Mei-yi-ben shu dou you yi-ge ren mai-le]]
= ∃X(∀x(x∈ X↔(**book** (x)& **CL**(x) =1)&∀y(y∈ X→∃v(**man**(v) & **bought**(y)(v)))

(26) [[Mei-yi-ben shu you yi-ge ren dou mai-le]]
=∃X(∀x(x∈ X↔(**book** (x)& **CL**(x) =1)& ∃v(**man**(v)& ∀y(y∈ X→ **bought** (y)(v)))

(25) means that for each book x, there is (possibly different) a person who bought x, while (26) means there is a particular person who bought each book.

There are several problems with YS. First, it is unclear how the compositionality problem is accommodated when '*mei*-CL NP' appears in object positions:

(27) Xiaozhang jiejian-le mei-ge xuesheng.
president meet-PERF MEI-CL student

According to Yang, *mei-ge xuesheng* denotes 'λQ(∃X(∀x(x∈ X↔(student'(x)& Cl'(x) =1)∧Q(X))', and it is of type <et, t>. Since QR is not an option for Chinese, it is unclear how *mei-ge xuesheng* combines with the transitive verb *jiejian* ('meet') to generate a term of semantic type <e, t>.

Second, Yang's account says little about indefinite/definite asymmetry.

(28) a. Mei-ge xuesheng chang-le yi-shou ge.
MEI-CL student sing-PERF one-CL song
b. * Mei-ge xuesheng chang-le zhe-shou ge.
MEI-CL student sing-PERF DEM-CL song

In (28a), *mei* not only has universal quantificational force, but also distributive force. Since there is no *dou*, the source of the distributivity in (28a) is left open in this account.

2.4 Summary

Lin (1998) proposes that '*mei*-CL NP' denotes a plurality and that *mei* is a determiner of type <et, e>, semantically akin to the definite article *the*. This analysis answers why *mei* can occur in object positions without incurring any scopal ambiguities. It also overcomes the compositionality problem when *mei* and *dou* co-occur. However, it overlooks the fact that *mei* alone can function as a universal quantifier, and it fails it fails to account for the indefinite/definite asymmetry. Huang (1996) proposes a straightforward solution to the puzzle of indefinite/definite asymmetry, but fails to account for subject/object asymmetry and certain other facts. Yang only looked at the *compositionality issue* when *mei* appears in subject positions and co-occurs with *dou*. While each proposal looks at part of the problem and provides an *account for its own part*, none has provided a unitary, comprehensively adequate solution to the problem of unraveling the intricate interaction between *mei* and *dou*.

3. A NOVEL ANALYSIS

We have shown that the existing accounts of *mei* and *dou* each address some part of the story, yet none of them offers a *comprehensively* adequate account of the multi-faceted intricate interactions between the two quantifiers. Our motivation is mainly *comprehensive*, that is, we base our analysis on two motivations: first, we preserve the previous

insights; second, we offer a *comprehensive* account for the story. This means, metaphorically, *that we need* to establish a *bridge* between the several accounts. But to what extent is such a *bridge* consistently reliable and plausible? Before we *build* such a bridge, some classifications have to be made. One is about the difference between standard universal quantification vs. distributive quantification.

Dowty & Brodie (1984) defines a distributivity operator (D-operator) on a VP as follows:

(29) $D_{VP} \Rightarrow \lambda X \forall y(y \in X \rightarrow VP(y))$, where X is a variable over plural individuals and y is a variable over *singular atomic* individuals

This definition of D-operator sometimes yields the same semantic result as a standard universal quantifier does. In standard GQT theory (cf. Barwise & Cooper (1981)), *every* is analyzed as just such a standard universal quantifier:

(30) EVERY $\Rightarrow \lambda P \lambda Q \forall x (P(x) \rightarrow Q(x))$, where P and Q are properties

The only difference between a distributive operator (here we will term it as distributive quantifier) and a standard universal quantifier thus lies in the nature of the domain within which the quantifiers operate. For a distributive quantifier, its domain of quantification is the singular atomic entities. For a standard universal quantifier, the only requirement seems to be totality. However, there have been some motivations for a further distinction between them.

First, given the definitions in (29) and (30), the semantic representation of a distributive quantifier would make no truth-conditional difference when compared with the semantic representation of a standard universal quantifier. If such is the case, why bother to have two distinct quantifiers and definitions rather than just one?

Second, *every*, the prototypical realization of universal quantifiers in English, seems to operate on a domain of countable, singular entities. This is evidenced by the singular morphology in *every* sentences. It is not possible for the mass nouns to contribute the domain of

quantification for *every*. Consider (31) below:

(31) a. Every man loves a woman.
b. * Every water is useful.
c. Every piece of information is to be conveyed.

After studying the behaviors of universal quantifiers and distributive quantifiers cross-linguistically (e.g., Georgian, Hebrew, English, etc.), Gil (1995) claims that we need a further distinction between universal quantifiers and distributive quantifiers. He distinguishes the universal quantifiers from distributive quantifiers by means of the following Universal:

(32) *Universal One [Quantifier Inventory]* (Gil 1995: 326)
If a quantifier is distributive-key, it is also universal.

(32) says that a distributive quantifier always yields the same semantic result as a standard universal quantifier, but not vice versa. In other words, a distributive quantifier contains more semantic content than a standard universal quantifier. But how can the asymmetric relationship between the distributive quantifier and standard universal quantifier be formally achieved?

Taking inspiration from Gil's proposal and from the many accounts of *mei* and *dou* in Chinese, we propose that the semantic representation of distributive quantification is standard universal quantification plus a matching function. The matching function applies and has semantic effect only when the domain of quantification is a plurality. The plurality requirement of distributive quantification receives a further motivation in the present account. Here is our proposal:

(33) Distributive quantification as a form of portmanteau quantification
The Distributive quantifier has a portmanteau semantic structure, namely, it is a standard universal quantifier plus a matching function

Before we provide the formal properties of the matching function, we explain the intuitions behind the hypothesis. Take English *each* as an

example. English *each* is always analyzed to be a genuine strict distributor, viz. it only operates on the domain of singular atomic entities. Consider the following example:

(34) The children *each* bought a cake.

Suppose there are four children, (34) is true in a situation where at least four (different) cakes are being bought:

(35) There is a set of children, x∈ X
There is an event of buying ONE cake, e
There is a set of cakes Y that are being bought, y∈ Y
Each member x of X is matched with an e which involves one y
… …
Four members of X are matched with four *e*s which involve at least four *y*s of Y

Somewhat formally, the truth conditions specified in (35) can be represented as follows:

(36) ∀x (x∈ **boy** →∃e ∃y (**cake** (y) & x buys one cake in e))

Could it be the case that the four boys bought the same cake? In theory, this reading is allowed by the following alternative representation:

(37) ∃y (**cake** (y) &∀x (x∈ **boy** → & x bought y))

(37) allows a particular cake that is being bought by each of the children (e.g., *every man is fond of a singer, that is Maria Carey*). The issue is that (34) does not have this reading. It has an inherent co-varying requirement. It is the co-variation that guarantees that each of the children bought a (different) cake. While English may rely on certain covert ways to realize this co-variation requirement, we propose that this semantic requirement has to be overtly specified in Chinese, just as adverbial quantification in Chinese is always overtly specified. In our

account, the co-variation is part of the inherent semantics of a distributive quantifier. This co-variation can be captured by a matching function defined as below:

(38) Matching Function
Let A and B be sets, π: B^A is a matching function *iff*
(i) $\forall x \in A\ \exists!y(y \in B \rightarrow \pi(x) = y)$
(ii) For $\forall x_1, x_2 \in A$, $x_1 \leq x_2 \Rightarrow \pi(x_1) \leq \pi(x_2)$
(iii) $\forall x_1, x_2 \in A$: $x_1 \neq x_2 \Rightarrow \pi(x_1) \neq \pi(x_2)$

The matching function is an injective function, and it is order-preserving (see (38ii)) and one-to-one (see (38iii)). We propose that *mei* in Chinese by default is a distributive quantifier. Based on (33) and (38), we provide the lexical entry for *mei* as follows:[3]

(39) MEI $\Rightarrow \lambda P \lambda R \forall x\ (P(x) = 1 \rightarrow \exists y\ (R(y)(x)\ \&\ \pi(x) = y))$, where P and R are predicates, π is a matching function

So, *mei* has two semantic components: it is the combination of the semantic representation of a standard universal quantifier ($\forall$) plus a matching function (π). The matching function takes members denoted by the restriction of the quantifier and matches them with an existentially introduced variable in the nuclear scope. This specifies the semantics of the co-variation: the value for the existentially introduced variable is dependent on the choice of the value for the variable previously introduced. This matching function is implicitly existentially introduced and its exact value is always left to context. A cluster of puzzles concerning *mei* receive a better treatment **in** this account.

[3] Please note that our new definition for *mei* resembles Huang's Skolem function. However, we overcome one of her difficulties, that of the *compositionality issue*. Her original definition is uncompositional (i.e., how an existentially introduced individual variable x *may be* extracted from a predicate variable, assuming that a quantifier only has two predicates as arguments, not individuals). Our matching function is inspired by Barwise (1979) and Rothstein (1995) by name.

4. EXPLAINING THE INDEFINITE/DEFINITE ASYMMETRY

This analysis provides a straightforward solution to the puzzle of how to account for the indefinite/definite asymmetry. Recall that *dou* is optional when there is an indefinite or a reflexive object within the scope of *mei*:

(40) a. Mei-ge xuesheng chang-le yi-shou ge.
MEI-CL student sing-PERF one-CL song
'Every student sang a song.
b. * Mei-ge xuesheng chang-le zhe-shou ge.
MEI-CL student sing-PERF DEM-CL song
'Every student sang this song.'

In (40a), the weak indefinite provides an existentially introduced variable to license the matching function. When there is an *individual constant* (denoted by definite NPs or proper nouns), the sentence will always be false according to the definition of the matching function. There is no co-variation in this case. It is this semantic violation that results in the oddness of (40b) without *dou*. In the present analysis, (40a) has the following semantic representation:

(41) $\forall x$ (x is a student $\rightarrow \exists y$ (y is a song & x sing y & π (x) =y))

In the semantic representation (41), the value for the object indefinite y depends on the value for the subject x, that is, y co-varies with x. Our analysis is compatible in spirit with that of Huang's (which is based on Skolemization). Skolemization replaces the narrow-scope existential quantifiers which are within the scope of universal quantifiers with a Skolem function. The following is a simple illustration:

(42) Skolemization:
$\forall x \exists y \phi(x, y) \Leftrightarrow \forall x \phi(x, f(x))$, where f is a Skolem function that maps x to y

Replacing the existential quantifier over y in (42), we arrive at the

following representation, which is equivalent to (42) when f is properly defined:

(43) ∀x (x is a student → x sing f(x))
f: a Skolem function that maps x to a song y , viz. for each x, there is a f(x) such that x sings f(x)

The semantic requirement of the co-variation has been captured effortlessly by the present account. (40a) only has the reading that the song varies with the students, i.e., each student sang a song, and different students sang a (non-accidental) different song. (40a) does not have the reading that all of the students sang the same song. We obtain a similar result when the object is a reflexive:

(44) Mei-ge xuesheng tan-le-tan ziji.
MEI-CL student talk-PERF-talk himself/herself
'Every student talked about himself/herself'

The literal semantic translation for (44) is (45) below:

(45) ∀x (x is a student → x talked about x)

(45) does not have an existentially introduced variable in the nuclear scope of the universal quantifier. To overcome the problem, we assume that the reflexives always have a hidden argument, namely, *ziji* = [*something x about*] *himself*/*herself*. It is this hidden argument that provides the existentially introduced variable to license the matching function:

(46) ∀x(x is a student → ∃y (y is about x & x talked about y & π(x) =y))

According to (46), (44) is true in a situation where Student A talked something about her courses, Student B talked something about his internship, and Student C talked something about her love story, and so on. The value of the things that are under discussion depends on the value for the students. Could it the case that the same material is being

talked about by each student? We think not. Pragmatically, this is NOT possible. Even if it is the same topic that is under discussion, presumably, each student has a different personal experience and it is this *difference* that licenses the co-variation.

Like Huang, our analysis is committed to a prediction that in Chinese, the indefinite object in the scope of *mei* cannot take a wide scope interpretation with respect to '*mei*-CL NP'. That is to say, the choice for the value of the indefinite object is always dependent on the choice of the value for the subject led by *mei*. This prediction has been borne out. The following example is from Huang (1996):

(47) Wenge de shihou, zai Wuhan, mei-yi-ge xiaohai
cultural-revolution DE time in Wuhan MEI-one-CL child
jiandaoguo yi-qi daren-shijian, # na-shi zai changjiang daqiao
saw one-CL beating-incident that-be at Yangtze bridge
fasheng de shiqing.
happen DE thing
'Every child witnessed a beating incident during Cultural Revolution in Wuhan, namely, the beating incident that happened at the Yangtze Bridge'.

(47) is unambiguous, i.e., the beating incident co-varies with the children. This explains the oddness of the extension *na-shi zai changjiang daqiao fasheng de shiqing* 'that is the beating incident *which* occured at the Yangtze Bridge'. The antecedent of (47) says that for each child, there must be a different beating incident that he/she witnesses, i.e., the value for the beating incident depends on the value for the child. The extension says that is a specific beating incident that every child witnessed. This semantic conflict is responsible for the oddness of the extension in (47). Consider one more example:

(48) a. Mei-ge ren xihuan yi-ge geshou, # na-shi Maliya Kaili.
MEI-CL person like one-CL singer that-be Maria Carey
'Everyone likes one singer, it is Maria Carey.'
b. Mei-ge ren dou xihuan yi-ge geshou, na-shi Maliya Kaili.
MEI-CL person DOU like one-CL singer that-be Maria Carey
'Everyone likes one singer, that is, Maria Carey.'

(48a) above is as odd as (47), due to the same reason. However, when *dou* is present, the extension *na-shi Maliya Kaili* 'it is Maria Carey' becomes acceptable, as shown in (48b). We turn to this contrast later on.

5. SOME EMPIRICAL MOTIVATIONS

5.1 Blocking Effects

If *mei* requires an indefinite to be within its immediate scope to satisfy the co-variation condition of the matching functional quantification, we predict that such a sentence might become unacceptable when (i) there is a constant within its scope (which flatly violates the conditions) or (ii) the indefinite variable is licensed by some other quantifying element in between, rather than the universal quantifier. The second case is the blocking effect. We consider the blocking effect with regard to negation in this section.

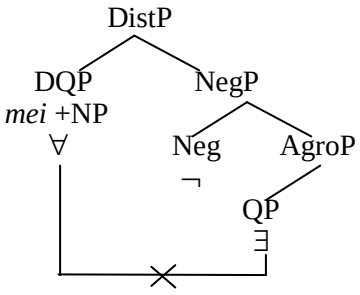
Here we consider the form '[*mei*…[NEG…[an/some NP]]]', in which the variable introduced by indefinite object is evaluated by the quantificational NEG rather than the universal quantifier. We expect some 'blocking effect' when negation comes in between *mei* and indefinite objects. This prediction is borne out. Consider the contrast between (49) and (50) below:

(49) a. * Mei-ge nanren bu xihuan yi-ge nüren.
MEI-CL man NEG like one-CL woman
Intended: 'Every man does not love a woman.'
b. * Mei-ge xuesheng meiyou xie yi-pian lunwen.
MEI-CL student NEG write one-CL paper
Intended: Every student did not write a paper.
c. * Mei-ge haizi meiyou chang yi-shou ge.
MEI-CL child NEG sing one-CL song
Intended: Every child did not sing a song.

(50) a. Mei-ge nanren xihuan yi-ge nüren.
MEI-CL man like one-CL woman
'Every man does not love a woman.'
b. Mei-ge xuesheng xie yi-pian lunwen.
MEI-CL student write one-CL paper
'Every student did not write a paper.'
c. Mei-ge haizi chang yi-shou ge.
MEI-CL child sing one-CL song
'Every child did not sing a song.'

We propose the following structure, following Beghelli & Stowell (1997), for the examples under (49):

(51)



The examples in (49) are unacceptable (or at least much more degraded than the ones without a negation). This phenomenon follows from our analysis. When a negation comes in, for example, (49a) would receive the following semantic representation:

(52) $\forall x$ (x is a man $\rightarrow \neg\exists y$ (y is a women & x loves y & $\pi(x) = y$))

(52) is semantically odd in that it says that for each x, there is no y such that π maps x to y. Recall that Skolemization applies only when the existential quantifier is within the immediate scope of a universal quantifier. This is not the case for (52), where the existential quantifier is not within the immediate scope of the universal quantifier. So Skolemization fails to apply. This accounts for the oddness of (49).

The blocking capacity of negation between distributive quantifiers and indefinites is also attested in English. The following observation is due to Beghelli & Stowell (1997):

(53) a. ?? Every boy didn't leave.
b. ?? Each boy didn't leave.

If we assume that English distributive quantifiers have the same semantic structure as Chinese ones, we might be able to provide a simple explanation for this phenomenon. In this account, (53) are as odd as (49) in Chinese.

One more word about the blocking effects. As pointed out by one reviewer, there are some other blocking effects too. For example, when A-not-A forms and some other quantificational elements (e.g**.,** *queshi* 'indeed', *zhende* 'really', etc.) sit between *mei* and its associated object, the sentences becomes odd:

(54) * Mei-ge ren xi-bu-xihuan yi-ge nüren?
MEI-CL person like-NEG-like one-CL woman
(55) *Mei-ge ren {queshi/zhende} xihuan yi-ge nüren.
MEI-CL person indeed really like one-CL woman

Mei may occur with the question marker *ma*, though:

(56) Mei-ge ren xihuan yi-ge nüren ma?
MEI-CL person like one-CL woman Q

This observation further corroborates our claim that *mei* requires an indefinite object within its immediate scope. The contrast between quantificational elements, A-not-A forms and question marker *ma* in this regard is mainly syntactic. The question marker *ma*, presumably, occupies a higher position (the traditional analysis is *that it projects* a CP), such that it c-commands *mei* and its associated argument. So there is no blocking effect between *mei* and the question marker *ma*. However, A-not-A forms and adverbial elements do not project CPs (they sit between VPs/IPs and CPs, such that they are c-commanded by *mei* while

c-commanding the objects) and are always below the subject, so **a** blocking effect surfaces when they are inserted between *mei* and its associated objects.

5.2 Distributive Sentences

Our analysis receives some further evidence from the so-called 'distributive sentences' in Chinese. This set of sentences share a common form, namely, '[Q1 NP] V [Q2 NP]', where Q2 and Q2 can be indefinite or numerals. As their name suggests, they have a distributive interpretation.[4] Consider the following example:

(57) Ba-ge xuesheng zhu liang-jian fang.
eight-CL student live two-CL room
'Every 8 student is assigned to two rooms.'
'Eight students share two rooms.'

(57) can mean that every eight students are assigned to two rooms, so the total students must be more than eight and rooms must be more than two. It does not have the collective reading, namely, that eight students share two rooms. This indicates that this sentence has a distributive semantics. This assumption is lent further support by the fact that in (53), a *mei* can be inserted before the first Q without any change in meaning (cf. Li (1965)). So, (57) is judged equivalent to the following (58):

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[4] Examples like (57) have been reported in the literature (Thomas Lee (p.c.) and Tsai (1994)). Tsai, for instance, argues that these examples have an implicit modal meaning. For example, *san-ge xuesheng chi wuwanfan* 'three students eat five bowls of rice' means *three students {may/can} eat five bowls of rice*. In this example, the indefinite subject is licensed by the implicit modal operator. The issue, however, is more complicated. In general, *mei* is optional in such sentences. However, when **an** aspect marker occurs, *mei* is not allowed and the distributive reading disappears:

(ii) a. (Mei) ba-ge xuesheng zhu liang-jian fang.
MEI 8-CL student live 2-CL room
b. *(Mei) ba-ge xuesheng zhu-le liang-jian fang.
MEI 8-CL student live-ASP 2-CL room

We leave this issue for further research.

(58) Mei-ba-ge xuesheng zhu liang-jian fang.
MEI-eight-CL student live two-CL room
'Every eight students are assigned to two rooms.'

On this account, (57) are genuine distributive sentences and always contain a null distributive quantifier. One more thing is noteworthy. In (57), the object QP cannot scope over the subject QP. As expected, when the object QP is a definite or a proper noun, the sentences become odd. Witness the oddness of the following examples:

(59) a. * (Mei)-san-ge ren xuan Xi'erdun jiudian de 1052 fangjian.
MEI-three-CL person choose Hilton hotel DE 1052 room
'Every three persons are assigned to Room 1052 of the Hilton Hotel.'
b. * (Mei)-san-ge ren anpai zhe-jian fangzi.
MEI-three-CL person assign this-cl room

(59a-b) contain definite objects (in (59a), it is 'Room 1052'; in (59b), it is 'this room'). The contrast between (57) and (59) is reminiscent of the definite/indefinite asymmetry in *mei*-sentences. We conclude that this parallelism cannot be mere coincidence and that the similarity speaks for a common treatment.

6. EXPLAINING THE SUBJECT/OBJECT ASYMMETRY

So far we have not yet explained the subject/object asymmetry. At a first glance, our account of distributive quantification, which bears some resemblance to Huang's analysis, face problems with this phenomenon. The relevant example is repeated below:

(60) You yi-ge xuesheng du-le mei-ben guanyu hanyu
have one-CL student read-PERF MEI-CL on Chinese
lianghua de boshi lunwen.
quantification DE PhD thesis
'A student read every PhD thesis on Chinese quantification.'
(a) ∃>∀ (b) *∀>∃)

In (60), the '*mei* NP' is in object position. Because we assume that '*mei* NP' is quantificational, it is of type <et, t>. It has a problem to combine with the transitive verb 'read', which is of type <e, et>. The traditional way to overcome this problem is to argue that the QP undergoes Quantifier Raising (QR) (cf. May (1977, 1985)), and leaves a trace of type *e* to combine with the transitive verb (cf. Heim & Kratzer (1998)). This strategy cannot be employed here, for robust empirical reasons. The empirical motivation for QR is the inverse scope reading. If QR indeed applies, we should expect, *mei-ben guanyu hanyu lianghua de boshi lunwen* 'every PhD thesis on Chinese quantification' in (60) to take a wide scope interpretation with respect to the indefinite subject *you yi-ge xuesheng* ('a student'). In this reading, the student varies with the PhD thesis, namely, that for each PhD thesis x, there is a (possibly) different student y such that y reads x. However, the sentence in (60) does not have this reading. This fact rules out QR in this example.

Another straightforward solution, as has been proposed by Lin, is that in (60), *mei* may be a determiner (of type <et, e>). The compositionality problem evaporates on this account. '*mei* NP' then is of type *e*, and it is happy to combine with the transitive verb. Lin takes *mei* to be a determiner like the English 'the', in our terms, it takes a set as its argument, and returns the maximal individual whose atoms are members of that set. In this sense, *mei* is inherently plural in Chinese. Despite this obvious advantage, this analysis faces some empirical difficulty.

In the previous section, we argued that *mei* is inherently distributive. The 'distributive' feature can be illustrated by comparing *mei* with the determiner that denotes a total plurality. Consider the following two examples:

(61) a. Xiaozhang jiejian-le mei-ge xuesheng.
president receive-PERF MEI-CL student
'The president received every student'
b. Xiaozhang jiejian-le quanbu de xuesheng.
president receive-PERF total DE student
'The president received all the students'

If the president received all the students at one time, people always prefer (61b) and disfavor (61a). However, if the president received the students one by one, each time receiving just one student, (61a) is to be preferred. This preference in judgment indicates that *mei* contains certain distributive semantics.

So, slightly unlike Lin, we propose that *mei* is a distributive determiner. Being a determiner, it has semantics similar to those of the definite article 'the'. Being distributive, it has a hidden predicate, which contributes the distributivity. In our account, the distributive determiner *mei* has the following semantics:

(62) *mei* as a distributive determiner
MEI $\Rightarrow \lambda P \exists X \Sigma x$ ($x \in X$ & $P(X)$ & $\forall Y$ ($Y \subseteq X \rightarrow C_i(Y)$), where C_i is a contextually provided predicate

The semantics given in (62) captures the two semantic components of *mei* as a distributive determiner: first, it is a determiner that operates on a set and returns a maximal individual whose subparts are atoms of that set; second, it is distributive, each subpart of the maximal individual has some property, which is always given by context. It has been proposed frequently proposed that each quantifier has an implicit domain restriction (cf. von Fintel 1994; Kratzer 2004; among others). This domain-restriction assumption can be incorporated into our semantics for *mei*. In the case of *mei*, this implicit domain of restriction is contributed by a hidden predicate. Unlike the other quantifiers, this hidden predicate contributes distributivity**.** In the example of (61a), this hidden predicate is something like 'arranged in a one-by-one manner'. This explains the distributive flavor of (61a). By contrast, *quanbu de xuesheng* 'the totality of the students' does not have this distributive feature, and this explains

the subtle difference between (61a) and (61b).

The afore-mentioned compositionality problem obtains a straightforward solution in this account. To take (61a) in illustration:

(63) Xiaozhang jiejian-le mei-ge xuesheng.
President receive-PERF MEI-CL student
(64) [[Xiaozhang jiejian-le mei-ge xuesheng]]
= the president received Σx (student(x) & C_i(x)) where C_i is a distributive predicate

(63) has a semantic representation as shown in (64), which means that the president received every student in some distributive manner. In this analysis, the object *mei-ge xuesheng* does not have to undergo QR to satisfy interpretability. If QR is motivated by the interpretability requirement (to avoid type-mismatch), we have reason to believe that Chinese does not need QR, and the problem of the type mismatch disappears.

Our analysis can be recast by means of domain-shifting, that is, *mei* lives in two domains, and when it is in the object position, it is in the domain of determiners. We will turn to the mechanisms that regulate this shifting presently. For the moment, we present more empirical motivations and considerations.

One motivation comes from the *determinerlessness* nature of Chinese. It is well-known that Chinese has no morphologically recognizable determiners (the morphological definite/indefinite article distinction does not exist in Chinese), however, this does not mean that Chinese does not have the definite article in a semantic sense. *mei* is a most ready candidate for this missing article, but its status as a semantic determiner can only be achieved by semantic operations. This idea has been advocated by many others, for instance, Yang (2001) has argued that in being determinerless, Chinese is more open to semantic type-shifting operations than English.

There is also some empirical evidence in support of this claim. We predict that when *mei* functions as a distributive quantifier (that is, a quantificational element), it cannot be referred back to in an inter-sentential discourse. (65a) shows that the subject '*mei* NP' in a

sentence with an indefinite object NP but without *dou* cannot be referred back; (65b) indicates that '*mei* NP' in object positions can be referred back by a plural pronoun but not a singular one. The contrast between (65a) on one hand and (65b) on the other indicates that *mei* indeed lives in two domains.

(65) a. [Mei-ge tongxue]$_i$ kan-le yi-bu dianying.
MEI-CL student watch-PERF one-CL movie.
Tamen$_{*i}$ / ta$_{*i}$ shi Zhang San de xuesheng.
They / he be Zhang San DE student(s)
'Every student$_i$ watched a movie. They$_{*i}$ / He$_{*i}$ are/is the student(s) of Zhang San.'

b. Wo jianguo zhe-ge xuexiao de [mei-ge laoshi]$_i$.
I meet DEM-CL school DE MEI-CL teacher
Tamen$_i$ /ta$_{*i}$ hen youhao.
they / (s)he very kind
'I met every teacher$_i$ in this school. They$_i$/(S)He$_{*i}$ are/is very kind.'

We still have to address several more important distributions concerning *mei* and *dou.* First, we mentioned that when the VP is intransitive, '*mei* NP' cannot occur in subject positions without *dou*. Please note that this restriction holds irrespective of the type of the predicate (e.g., *stage-level* predicates vs. *individual-level* predicates, cf. Kratzer (1995)). This happens even when the VP is a stage-level one (which introduces an event argument). Since we assume that *mei* as a distributive quantifier is licensed by a lexically existentially introduced variable in its nuclear scope, we wonder why the existentially introduced event variable cannot license *mei* as below:

(66) * Mei-ge xuesheng lai le. [intransitive, without *dou*]
MEI-CL student come PERF
'Every student came.'

Second, *dou* can always be inserted when '*mei* NP' leads the subjects, regardless of the type of the object and the predicates:

(67) a. Mei-ge xuesheng dou chang-le yi-ge ge. [indefinite object]
MEI-CL student DOU sing-PERF one-CL song
'Every student sang one song.'
b. Mei-ge xuesheng dou chang-le zhe-ge ge. [definite object]
MEI-CL student DOU sing-PERF DEM-CL song
'Every student sang this song.'
c. MEI-CL xuesheng dou lai le. [intransitive VP]
MEI-CL student DOU came PERF
'Every student came.'

Then, what is the semantic contribution of *mei* in the examples under (67)? Is it a quantifier or a determiner? Is there any semantic difference between the sentences with *dou* and the ones without *dou*? These are the hardest problems concerning *mei* and *dou*. We discuss these issues in the next section.

7. WHEN *MEI* AND *DOU* COME TOGETHER

7.1 *Dou* as a Distributive Quantifier over Events

The Mandarin *dou* has been a subject of much discussion. The following (69) shows the distributional pattern of *dou* (cf. Lee 1986; Cheng 1995; Liu 1990; Lin 1998; Li 1998; Wu 1999; Yang 2001; Tomioka & Tsai 2005; Xiang 2008; among others**):**

(68) The distribution of *dou* (see Cheng (1995: 198) for details):
(a) *dou* must occur pre-verbally;
(b) *dou* quantifies a plural NP that is located to its left side;[5]
(c) *dou* and its associated NP are subject to locality conditions.

Examples (all with neutral stress)

(69) a. [Zhe-xie xuesheng] dou xihuan Haolaiwu de dianying.
DEM-PL student DOU like Hollywood DE movies
'These students all like the Hollywood movies.'
b. * [Zhe-xie xuesheng] xihuan dou Haolaiwu de dianying.
(70) a. [Zhe-xie shu] wo dou xihuan. (topic)
DEM-PL book I DOU like
'As for these books, I like them all.'
b. * Wo dou xihuan zhexieshu.
(71) a. [Zhe-xie xuesheng] dou lai le. (subject)
DEM-PL student DOU come PERF
'These students all came.'
b. *Dou lai-le zhe-xie xuesheng.

[5] In the literature, this condition is also known as the 'Leftness Condition' (cf. Lin (1998: 215) for details). However, there are apparent counterexamples to this observation. It has been reported at various places in the literature that *dou* seems to able to associate with an argument to its right side (cf. Li 1995, Zhang 1997, and more recently, Luo 2009):

(iii) a. Tamen dou mai nizi de yifu.
they DOU buy woolen DE clothes *('nizi' = woolen?)*
b. Ni dou mai shen-me?
you DOU buy what

One motivated account for these examples is that *dou* still associates with an argument to its left side, albeit in a different domain, i.e., the domain of (contextually-provided) events/situations. Luo, for example, argues the correct semantics for (iii(a)) is as follows:

(iv) For *a contextually provided events* X (e.g., events of buying clothes), each x of X is associated (matched) with an event in which they buy woolen clothes.

This analysis is compatible with the one proposed in this study. But the observation merits a separate paper and we have to leave it aside.

(72) a. [Zhe-xie xuesheng] wo dou xihuan.
DEM-PL student I DOU like
'As for these students, I like them all.'
b. * [Zhe-xie xuesheng] zhidao wo dou xihuan Guojing.
DEM-PL student know I DOU like Guojing
'All of the students know that I like Guojing.'
(Cheng 1995, examples (4a-b))

The contrast between (69a-b), (70a-b), (71a-b) and (72a-b) follows from (68) in a straightforward manner. For instance, (70b) is out because there is no plural denotation located to the left side of *dou* (thus violating the Leftness Condition), and (72b) is out because the locality constraint is not observed. The issue is how this distributional pattern can be explained. It has been widely proposed that *dou* is a distributor, and that its domain of quantification is provided by the plural NP which is located to its left side. Supposing that *dou* quantifies over a plural individual, we repeat the standard wisdom of *dou* as a distributor as follows:[6]

(73) *Dou*$\Rightarrow$ $\lambda x \lambda P \forall y(y \leq x \rightarrow P(y))$, where x is a plural individual and P is a predicate

(73) says *dou* takes two arguments, one is a plural individual and the other is a predicate. *Distribution* means each part of x has the property of P.[7] We would also like to add events to the picture.

We assume that all predicates introduce an event argument into the semantic representation. (73) has no place for this event argument. Also,

[6] It is still a continuing debate if a common core semantics for *dou* can be provided (**i.e.,** whether it is a distributor or a universal quantifier, or, an exhaustivity operator, cf. Zhang (2008)). Our suggestion is positive. One motivation is that these notions are not radically in conflict with each other. Logically, there is much in common between universal quantification and exhaustivity. Given a set of N members, when one *exhaustively* counts over N members, one reaches a universal statement. However, a fuller discussion of *dou* is beyond the limit of this paper.

[7] It should be noted that the domain of *dou* need not be all atoms, thanks to an observation due to Lin (1998). In lattice-theoretic terms, *dou*'s domain of quantification can contain atoms, sums, etc. as long as they constitute a plurality (with ***(of?)*** elements more than two).

(73) is not portmanteau. We argued in Section 4 that a distributive quantifier always has two semantic components, i.e., a standard universal quantifier plus a matching function. These two elements can be incorporated into the semantics of *dou*, making it compatible with what we arrived at earlier:

(74) *Dou* as a distributive quantifier over events
Dou $\Rightarrow$ $\lambda x \lambda P \forall y(y \leq x \rightarrow \exists e\ (P(y)(e)\ \&\ \pi(x) = e))$, where P is a predicate, and π is a matching function

The revised version (74) meets our needs. Given (74), a typical *dou*-sentence like (75a) would receive a semantic representation like (75b):

(75) a. Jiaoshou-men dou lai le.
professor-PL DOU came PERF
'The professors all came.'
b. $\forall x(x \leq \iota y.\ \text{professors}\ (y) \rightarrow \exists e\ (\text{came}\ (x)\ (e)\ \&\ \pi(x) = e))$

(75b) says that each part of the plural individual 'the professors' participates in a coming event. Due to the atomicity nature of the predicates (*lai* 'come'), *dou* necessarily operates on atoms, **i.e.,** each atomic member of *professors* is involved in a *coming event*. The sentence is true if each professor of a certain (contextually-provided) domain came. It is easy to see that our new account of *dou* gives exactly the semantic result as the standard one.

But there is a potential problem here. Since the distributive quantifier analysis (74) assumes that *dou* is a quantifier, a compositionality problem arises when *mei* co-occurs with *dou*. Because, *mei* is also assumed to be quantifier. Consider:

(76) a. Mei-ge xuesheng dou chang-le yi-ge ge. [indefinite object]
MEI-CL student DOU sing-PERF one-CL song
'Every student sang one song.'

b. Mei-ge xuesheng dou chang-le zhe-ge ge.[definite object]
MEI-CL student DOU sing-PERF DEM-CL song
'Every student sang this song.'
c. Mei-ge xuesheng dou lai le. [intransitive VP]
MEI-CL student DOU came PERF
'Every student came.'

Matthewson has suggested that when *mei* and *dou* co-occur, one of them becomes a determiner. For all the plausibility of this account, there is *still* a conceptual gap to be filled. Is there any deep motivation as to why one of them becomes a determiner, let alone any empirical motivation?

7.2 When *mei* and *dou* Co-occur: Domain Shifting as a Last Resort

Before proceeding, we would like to examine another solution to the co-occurrence puzzle between *mei* and *dou*. Yang (2001) suggests that when *mei* and *dou* co-occur, *mei* is a universal quantifier and *dou* contributes the distributivity. His semantics for *mei* is repeated here as (77) below:

(77) *Mei* $\Rightarrow \lambda P \lambda Q(\exists X(\forall x(x \in X \leftrightarrow P(x)) \wedge Q(X)))$

This analysis suffers from at least two problems. First, as we have already mentioned, it fails to account for the fact that *mei* alone can be a distributive quantifier, as long as there is an existentially introduced variable within its scope. Second, this analysis is committed to a claim that the domain of *mei* is inherently plural. This seems wrong.

It is well-known that *mei* always forms a sequence with classifiers and numerals, resulting in a form like '*mei*-numeral-classifier-NP'. Syntactically, this sequence must be analyzed as [*mei* [numeral-classifier NP]], that is, the numeral-classifier sequence first combines with the head noun, and the whole sequence then functions as an argument for *mei*. This analysis is welcome and is compatible with the syntactic behavior of *mei* (which always sits in a determiner's position). According to (77), the argument of *mei* must be plural, that is,

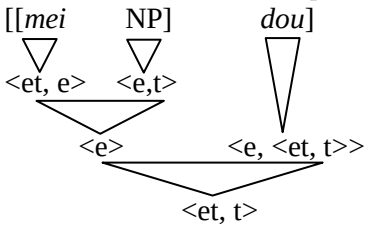
[numeral-classifier NP] denotes a plurality. This needs not always be case. We find that a numeral meaning 'one' can always be inserted between *mei* and its argument. Consider:

(78) a. mei-yi-ge xuesheng
MEI-one-CL student
b. mei-yi-ci xingdong
MEI-one-CL activity
c. mei-yi-ge gushi
MEI-one-CL story

The sequences like *yi-ge xuesheng* 'one student', *yi-ci xingdong* 'one campaign' etc. must be inherently singular. If so, this casts doubt on (77). These empirical facts, however, prompt the analysis that *mei* is a determiner. But this can only be achieved by a maximality operation, that is, *mei* takes a set as its argument and returns the maximal individual whose atoms are members of that set. This operation is similar to the sigma-operation in Link (1983). We have included this maximality semantics into our analysis for *mei* (in our account, *mei* is a maximality operator, and it carries the presupposition that the maximalized individual is *distributive* in a contextually-provided manner).

So, let us assume that when *mei* and *dou* co-occur, *mei* is a determiner and *dou* is a quantifier. The compositionality problem disappears, because *dou* is of type <e, <et, t>> and *mei* is of type <et, e>. When *mei* leads the subject, it takes a predicate at its argument and returns an individual of type e, which forms the distributable domain for *dou*. When it is in an object position, no compositionality issue arises. We arrive the following structure for the cases in which *mei* and *dou* co-occur:

(79) The semantic structure of [*mei* NP *dou*] ($VP_{<e,t>}$)



This analysis doesn't have the compositionality problem. This analysis receives some further theoretical and empirical motivations. First, the type-driven Principle of Full Interpretation (PFI) in the sense of Heim and Kratzer (1998) compels this. Second, there is no other way to satisfy the PFI except by this kind of domain shifting. The domain shifting is regulated by an independently motivated constraint: the Economy Constraint. We look at these motivations one by one.

First let us consider the facts: the cases in which *dou* is optional and the cases in which it is obligatory. We start with the obligatory case.

When *mei* leads the subject NP and the main predicate is objectless, we noticed that *dou* is always obligatory. Consider the following contrast between (80a) and (80b):

(80) a. *Mei-ge xuesheng lai le.
MEI-CL student come PERF
'Every student came.'
b. Mei-ge xuesheng dou lai le.
MEI-CL student DOU come PERF
'Every student came.'

Type-logically, if we treat *mei* in (80a) as a quantifier, there is no problem of a type mismatch and the sentence should be fine. This prediction is borne out. The question is why *mei* cannot be such a quantifier in this case. The contrast can be attributed to a distinction between event quantification and individual quantification and a division of labor between *mei* and *dou* when both are quantifiers. When *mei* functions as a quantifier, it only matches an individual with another individual, that is, it only operates on domains of individuals. (80a) is

odd, as expected (it is odd because it lacks a lexically existentially introduced variable over individuals in its scope, and the matching function is not satisfied).

The other possibility is that *mei* is a determiner in (80a). In this analysis, (80a) should be as fine as the following (81), which has a definite subject:

(81) Zhe-xie xuesheng lai le.
DEM-PL student came PERF
'These students came.'

The oddness of (80a) indicates *mei* in it is also not a determiner. But why is this so? Again, there is no compositionality problem when *mei* is treated as a determiner. We attribute this to an independently motivated Economy Constraint. The type-shifting of *mei* from quantifier to determiner is not without restriction. This kind of shifting is costly, and it applies always as a last-resort rescue strategy to satisfy interpretability. *mei* by default is a quantifier, and it becomes a determiner only when the interpretability cannot be satisfied or another rescue strategy is more costly. When *mei* in (80a) is interpreted as a quantifier, the interpretability is satisfied, and there is no motivation for type-shifting. It is this economy constraint that rules out *mei* from being a determiner in (80a). In (80b), the situation is different. *mei* cannot remain a quantifier here, because there is another quantifier *dou.* Type-driven interpretability requires *mei* to be a determiner, and since *dou* operates on events, (80b) is fine. In other words, two semantic modules operate in parallel fashion to determine the distribution of *mei*: the distributive requirement requires that there is an existentially introduced *individual* variable within *mei*'s scope; the type-driven Principle of Full Interpretation (PFI) dictates that there is no type mismatch. Only when these two conditions are met, is *mei* licensed. These two different semantics go hand in hand to explain the contrast between (80a) and (80b).

The other cases in which *dou* is optional also receive a satisfactory treatment in this analysis. Empirically, the sentence with *dou* and the one without *dou* are semantically different. Consider:

(82) a. Mei-ge xuesheng chang-le yi-ge ge.
MEI-CL student sing-PERF one-CL song
b. Mei-ge xuesheng dou chang-le yi-ge ge.
MEI-CL student DOU sing-PERF one-CL song

(82a) is true, and only true in a situation where for each student x, x sang a (non-accidentally) different song. The choice of the value for the songs depends on the choice of value for the students. (82b), by contrast, can be true if for each student x, x sang the same song. Because *dou* operates on events, so, even if in the domain of individuals, it is the same song that is being chosen, however, in the domain of events, the event where Student A chose a song x is DISTINCT from the event where Student B chose a song x. This licenses the *accidental-same-song* reading. The subtle difference in meaning between (82a) and (82b) thus is explained. In the present account, they receive distinct semantic representations, despite their superficial similarity. (83a) below is the semantic representation for (82a) and (83b) for (82b)):

(83) a. $\forall x$ (**student(**x) $\rightarrow \exists y$ (**song**(y) & **sang**(y) (x) & π(x) =y))
b. $\forall x$ (x$\leq \Sigma x$.***student**(x)$\rightarrow \exists e \exists y$ (**song**(y) & **sang**(y)(x)& π(x)=e))

This semantic contrast is further corroborated by the following examples:

(84) a. Mei-ge xuesheng chang-le yi-ge ge,
MEI-CL student sang-PERF one-CL song
?/* na shi Zuori Chongxian.
that be *Yesterday Once More*
b. Mei-ge xuesheng <u>dou</u> chang-le yi-ge ge,
MEI-CL student DOU sing-PERF one-CL song
na shi Zuori Chongxian.
that be *Yesterday Once More*

The following supporting example is from Huang (1996:45)

(85) a. Wenge de shihou, zai Wuhan, mei-yi-ge xiaohai
cultural-revolution DE time in Wuhan MEI-one-CL child
jiandaoguo yi-qi daren shijian.
saw one-CL beating incident
'Every child witnessed a beating incident during the Cultural Revolution in Wuhan.'

b. Wenge de shihou, zai Wuhan, mei-yi-ge xiaohai
cultural-revolution DE time in Wuhan MEI-one-CL child
dou jiandaoguo yi-qi daren shijian.
DOU saw One-CL beating incident
'Every child witnessed a beating incident during the Cultural Revolution in Wuhan.'

(85a) is unambiguous, i.e., the beating incident co-varies with the seer, and for each child x, x necessarily saw a different beating incident. (85b) is ambiguous, i.e., it allows a reading which says there is a particular beating incident such that each child x saw it. This subtle semantic difference is expected in the present analysis. To put it simply, when *dou* is present, it always matches each individual with an existentially introduced event. Since the accidentally same individual can repeatedly show up, we expect the same-individual reading, as (85b) shows.

8. HOW NATURAL IS DOMAIN SHIFTING?

We have suggested that *mei* lives in two domains, i.e., the domain of quantifiers and the domain of determiners. Interpretability and economy oversee the shifting between them. This analysis relies on domain shifting. Domain shifting is nothing novel in semantics. Partee (1987) shows that a nominal element can be either quantificational or referential, depending on the context. She proposes a set of type-shifting principles to capture this phenomenon. Recently, Kratzer (2004) also made some similar remarks about the domain shifting in natural languages:

> 'Domain shifts carried by determiners seem to be at the heart of quantifier constructions, then, be they nominal or sentential. It is thus very important to think about possible and impossible domain shifts. Are there such things as 'simple' or 'natural' operations on quantificational domains, for example? Which ones of those have to be lexicalized overtly? Which ones can be constructional or carried by zero-morphology?'

The point is about how natural the domain shifting is. The facts about *mei* and *dou* in Chinese indicate that domain shifting must be *economy-regulated*. By 'natural' we mean *motivated*. That is, domain shifting happens naturally only when there is a strong motivation. Domain shifting *is to* to satisfy interpretability, and this only happens in two situations: whether there is no other way to satisfy interpretability or the other ways are more costly than domain shifting. Domain shifting is regulated by an independently needed Economy Constraint:

(86) Principle of Economy:
> Interpret *mei* as a determiner only as a last resort to satisfy interpretability.

Let us have a further look at how this economy-based analysis provides a natural, unitary analysis of the many complicating facts about *mei* and *dou*. *mei* is originated as a distributive quantifier. But when it is in object positions, there is a problem as far as interpretability is concerned. Because the *mei-cl* NP is of type <et, t>, it cannot combine with the transitive verb, which is of type <e, et>. We have three strategies to overcome this problem. We can (a) type-shift the verb, (b) QR the quantificational phrase or (c) domain-shift *mei* to be a determiner. Type-shifting the verb leads to some unwelcome consequence for the whole system (cf. de Swart (2001)). As for QR, there is no empirical evidence that QR actually applies as far as scope is concerned (that is, the object quantifier phrase cannot take an inverse scope reading with regard to the subject quantifier phrases). The only remaining strategy is to domain-shift *mei* from a quantifier to a determiner. When *mei* leads the subject NP, the situation is different. In this case *mei* cannot be

domain-shifted into a determiner, since to interpret it as a quantifier leads to no problem in interpretability. It is then left to distributive quantification to oversee if the semantic requirement is met. When *dou* comes in, there arises an interpretability problem. To satisfy interpretability, *mei* becomes a determiner. This explains the obligatoriness of *dou*. This combination of factors *create*s the impression that *dou* licenses *mei*.

If the analysis proposed in this paper is on the right track, we expect that English distributive quantification will also have a portmanteau semantic structure. It is a merely lexical accident that the distributive quantification in English is realized by *every* and in Chinese by *mei* and *dou*. Chinese indefinites, by nature, are no different from those in English. Namely, both denote properties. Having said such, we face a problem: why doesn't the sentence like the following (87) in Chinese display the same scope ambiguity as its English counterpart?

(87) Mei-ge xuesheng chang-le yi-ge ge.
MEI-CL student sing-PERF one-CL song
(a) ∀>∃; (b) * ∃>∀)
To compare: Every student sang a song. ((a) ∀>∃; (b) ∃>∀))

Another problem also arises here. If weak indefinites all denote properties, there arises a question about compositionality: how to properly combine a transitive verb of type <ee, t> with an indefinite (of type <e, t>)? We propose that English and Chinese each satisfy this requirement in a different way. Chinese employs Predicate Restriction, a mode of composition which takes the property argument (of type <e, t>) as a restrictive modifier of the predicate (cf. Chung & Ladusaw (2004)), while English uses the choice function (CF) which maps a property argument onto entities that have the property (cf. *inter alia* Reinhart (1997, 2006); Kratzer (1998); Winter (2004)). But after existential closure (EC), both the mechanisms yield a semantic category of type e to combine properly with the transitive verb. This analysis has an extra benefit: it explains why object indefinites in Chinese always receive the narrow-scope reading, while English object indefinites may receive a wide-scope reading with respect the quantified subject:

(88) Predicate Restriction in Chinese
[[xihuan yi-ge nüren]]
= RESTRICT (λxλy (**like**(y)(x) , **a woman**))
= λxλy(**like**(y)(x) & **woman**(y)) (Predicate Restriction)
= λx∃y(**like**(x) (y) & **woman** (y)) (Existential Closure)

(89) Choice Function in English
[[a woman]] = $\lambda f \in D_{<e, t>}$. CF(f) (**woman**)
= ∃f(CF(f)∧f(**woman**)) (Existential Closure)

While it is beyond the scope of this paper to seek further empirical motivations for the above cross-linguistic proposal, some of the merits of the proposal have been discussed in this paper. For example, it correctly predicts the systematic narrow-scope reading of weak indefinites in Chinese vs. the ambiguous scopal readings of weak indefinites in English.

Since English *every* is capable of quantifying over events (unlike Chinese *mei* but like *dou*), we expect that English *every* is not subject to the same restriction as *mei*. This prediction again is borne out:

(90) a. Every man loves a woman.
b. Every man knows the women (I met yesterday).
c. Everybody came.

(90a) contains an overt indefinite within the scope of 'every NP', and the Skolemized quantificational requirements are satisfied. In (90b) and (90c), it is the covertly existentially introduced event argument that is within the scope of 'every NP'. (90b) and (90c) thus receive the following semantic representations (91a) and (91b), respectively:

(91) a. ∀x (**man**(x) → ∃e (**know-the-woman**(e)(x) ∧π(x) =e)) (= (90b))
b. ∀x (**man**(x) → ∃e (**came**(e) (x) ∧ π(x) =e)) (=(90c))

The above discussion predicts that when the covert existential quantification over event argument is blocked, the sentences would become odd, due to the failure to satisfy the matching functional

requirement involved in distributive quantification. We have shown that the quantificational negative NEG can block the co-variation between the indefinite and the universal quantifier. It is not surprising that English behaves no differently from Chinese. The following English examples are from Beghelli and Stowell (1997):

(92) a. ?? Every boy didn't leave.
b. ?? Each boy didn't leave.

9. CONCLUSION

This study addresses two outstanding puzzles about the two well-known quantifiers *mei* and *dou* in Chinese. The first puzzle we looked at is the indefinite/definite asymmetry puzzle when *mei* leads the subject NP. *dou* is not needed when there is an indefinite or a reflexive object in this case. This puzzle can be explained away by assuming that *mei* is a distributive quantifier. Being a distributive quantifier, it has two semantic components, i.e., it is a standard universal quantifier plus a matching function. The matching function requires the choice of the value for the object to be dependent on the choice of the value for the subject. When the object is a definite or a proper noun, this semantic requirement is not satisfied, resulting into a semantic violation. We then look at the subject/object asymmetry puzzle. When *mei* leads the subject NP, its distribution is restricted, depending on the type of the *predicate* and the type of the *object*. By contrast, when it leads the object NP, its distribution is much freer. We assume that it is because *mei* has been domain-shifted into a determiner in this case. This claim is lent further empirical support by the fact that when *mei* leads the object NP, it patterns with definites in not displaying scope ambiguity or referential NPs which are able to be anaphorically used. However, domain-shifting does not come for free. It is regulated by the *Principle of Economy*. We have managed to preserve the major insights of the previous studies (esp. the analysis proposed in Lin (1998) and Huang (1996)) in this paper.

The puzzle of the co-occurrence (constraint) between *mei* and *dou* has been a topic of discussion for a long time. We have shown that the

co-occurrence is a mere illusion. That is, there is a division of labor between *mei* and *dou*, and each has its own semantic requirements. Separate semantic principles operate in parallel fashion to determine the behaviors of *mei* and *dou*. A comprehensive analysis will not be possible until these factors have been carefully studied and their semantic contributions teased apart from each other. We believe that the change of viewpoint argued for in this paper will lead to some welcome consequences in future studies of *mei* and *dou*, and quantification in Chinese in general.

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“每”與“都”：量詞與量化

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本文討論漢語中有關“每”和“都”的兩個難題：(1) 有定/無定不對稱難題：雖然大多數情況下“每”需要“都”伴隨出現，但是，當賓語是無定的時候，“都”可以不需要出現；(2) 主賓不對稱難題：“每”在主語位置出現受諸多限制，與之對立的是，“每”在賓語位置的出現相對自由許多。我們對這兩個難題提出了一個統一的分析：(1) 第一個難題可以通過假設所有的分配量化具有雙層語意結構來解釋：“每”作為分配量詞，其基本語義是一個標準的全稱量詞加上一個匹配函數，匹配函數保證了分配量化中的“同步協變”語意要求；(2) “每”可以通過類型轉換，由分配量詞轉換成分配限定詞，這是“每”在賓語位置出現時的情況；(3) 類型轉換總是受經濟原則支配。有關“每”和“都”的許多複雜的問題，在本文的分析中得到了更好的處理。

關鍵詞：分配量化，限定詞，量詞，*每*，*都*