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Quantification and Predication in Mandarin Chinese: A Case Study of Dou

Abstract

In the more recent generalized quantifier theory, 'every' is defined as a relation between two sets such that the first set is a subset of the second set (Cooper (1987), van Benthem (1986)). We argue in this dissertation that the formal definition of 'every' ought to reflect our intuition that this quantifier is always associated with a pairing. For instance, 'Every student left' means that for every student there is an event (Davidson (1966), Kroch (1974), Mourelatos (1978), Bach (1986)) such that the student left in that event.

We propose that the formal translation of **EVERY** be augmented by relating its two arguments via a skolem function. A skolem function links two variables by making the choice of a value for one variable depend on the choice of a value for the other. This definition of **EVERY**, after which 'every' and its Chinese counterpart 'mei' can be modeled, can help us explain the co-occurrence pattern between 'mei' and the adverb 'dou'.

It was observed in S.-Z. Huang (1995a) that 'mei' requires either 'dou', or an indefinite phrase, or a reflexive in its scope. Under the skolemized definition of **EVERY**, this is explainable: The skolem function needs a variable in the scope of **EVERY**. We stipulate that only morphologically/lexically licensed variables are available for quantification (of this kind). 'Dou' occurs with 'mei' because 'dou' can license the event variable for skolemization. This function of 'dou' is performed by the tense operator in English, while Chinese, lacking tense, resorts to 'dou'.

'Dou', we will argue, is a sum operator on the event variable. Thus, 'dou VPs' always assert plural events, which predicts that the distribution of 'dou' may or may not involve universal quantification. Among other things, our account explains scope ambiguity in Chinese, the optionality of 'dou', and the interchangeability, in a number of contexts, between 'dou' and conjunction/additive words for VPs such as 'ye' "also, and", 'you' "also, again", and 'hai' "also, still".

Comments

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QUANTIFICATION AND PREDICATION IN MANDARIN CHINESE:
A CASE STUDY OF *DOU*

Shi-Zhe Huang

A DISSERTATION

in

Linguistics

Presented to the Faculties of the University of Pennsylvania in Partial
Fulfillment of the Requirements for the Degree of Doctor of Philosophy

1996

Supervisor of Dissertation: Anthony S. Kroch

Graduate Group Chairperson: Donald A. Ringe

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By

Shi-Zhe Huang

TO MY PARENTS:

LI XIANKUN & HUANG LUQUAN

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ABSTRACT

QUANTIFICATION AND PREDICATION IN MANDARIN CHINESE:
A CASE STUDY OF *DOU*

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Supervisor: Anthony S. Kroch

In the more recent generalized quantifier theory, 'every' is defined as a relation between two sets such that the first set is a subset of the second set (Cooper (1987), van Benthem (1986)). We argue in this dissertation that the formal definition of 'every' ought to reflect our intuition that this quantifier is always associated with a pairing. For instance, 'Every student left' means that for every student there is an event (Davidson (1966), Kroch (1974), Mourelatos (1978), Bach (1986)) such that the student left in that event.

We propose that the formal translation of EVERY be augmented by relating its two arguments via a skolem function. A skolem function links two variables by making the choice of a value for one variable depend on the choice of a value for the other. This definition of EVERY, after which 'every' and its Chinese counterpart 'mei' can be modeled, can help us explain the co-occurrence pattern between 'mei' and the adverb 'dou'.

It was observed in S.-Z. Huang (1995a) that 'mei' requires either 'dou', or an indefinite phrase, or a reflexive in its scope. Under the skolemized definition of EVERY, this is explainable: The skolem function needs a variable in the scope of EVERY. We stipulate that only morphologically/lexically licensed variables are available for

quantification (of this kind). 'Dou' occurs with 'mei' because 'dou' can license the event variable for skolemization. This function of 'dou' is performed by the tense operator in English, while Chinese, lacking tense, resorts to 'dou'.

'Dou', we will argue, is a sum operator on the event variable. Thus, 'dou VPs' always assert plural events, which predicts that the distribution of 'dou' may or may not involve universal quantification. Among other things, our account explains scope ambiguity in Chinese, the optionality of 'dou', and the interchangeability, in a number of contexts, between 'dou' and conjunction/additive words for VPs such as 'ye' "also, and", 'you' "also, again", and 'hai' "also, still".

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Chapter 1

Introduction

1.1. The Issues

In the more recent generalized quantifier theory, 'every' is defined as a relation between two sets such that the first set is a subset of the second set (Cooper (1987), van Benthem (1986)). We argue in this dissertation that the formal definition of a distributive universal quantifier ought to reflect the fact that such a quantifier can always be interpreted as being associated with a pairing. For example,

- (1) a. Every child sang a song.
- b. Every student left.

We can interpret (1a) to mean that for every child there is a song such that the child sang the song, and interpret (1b) to mean that for every student there is an event such that the student left in that event (Following Davidson (1966), Kroch (1974), Mourelatos (1978), and Bach (1986), we include event as part of our ontology in addition to individuals. The term 'event', which Davidson originally used for the extra event argument in a sentence with an action verb, stands in for

'eventuality' that Bach defined as covering "states, processes, and events" (ibid., 65)).

Let EVERY represent any distributive universal quantifier that is a relation between A and B, we propose that the formal translation of EVERY be augmented by relating its two arguments A and B via a skolem function. A skolem function links two variables by making the choice of a value for one variable depend on the choice of a value for the other. This definition of EVERY, after which 'every' and its Chinese counterpart 'mei' can be modeled, can help us explain not only the distribution of 'every' and 'mei', but also the co-occurrence pattern between 'mei' and the adverb 'dou'.

It was observed in S.-Z. Huang (1995a) that 'mei' requires either 'dou', or an indefinite phrase, or a reflexive in its scope.

The following is a set of data from S.-Z. Huang (1995a) that supports this empirical generalization.

When the object NP is definite or the verb is intransitive and there is no indefinite adverbial modifier, 'dou' is required:

(2) *meiyige ren *(dou) kan le zheiben shu.*
every-MW person dou readLE this-MW book
"Every person read this book."

(3) *meiyige xuesheng *(dou) biye le.*
every-MW student dou graduateLE
"Every student graduated."

But the sentences are fine if one of the three things happens: The object NP is indefinite as in (4), or the object NP is a reflexive as in (5) or there is an indefinite adverbial phrase within the VP as in (6):

(4) *meiyige chushi zuo yige cai.*
every-ME chef make one-MW dish
"Every chef makes a dish."

(5) *meiyige haizi you ziji de chuang.*
every-ME child has self DE bed.
"Every child has his own bed."

(6) *meiyige gexing hong le yi nian.*
every-ME singing-starred LE one year
"Every singing star was popular for a year."

This set of data raises several questions: Why does a universal quantifier in Chinese require in its scope either indefinites, or bound variables, or 'dou'? What do the three things have in common? Why is it that this is true in Chinese but not true in English? Would the comparison between Chinese and English help reveal some intrinsic properties of distributive universal quantification that has not been reflected in the formal representation?

Our research guided by these questions has led to our current thinking of defining EVERY with a skolem function. Under the

skolemized definition of EVERY, the above data can be explained as follows. The skolem function needs a variable in the scope of EVERY in order to construct the second set from the pairings created from the first set. We stipulate that only morphologically or lexically licensed variables are available for quantification at the first stage of interpretation. Indefinites and reflexives are lexical elements that introduce variables into logical translations. 'Dou' occurs with 'mei' because 'dou' can lexically license the event variable for skolemization, especially when neither indefinites nor reflexives are present in the sentence. This function of 'dou' is performed by the tense operator in English, while Chinese, lacking tense, resorts to 'dou'.

Also of great relevance to our understanding of 'dou' is the interchangeability, in a number of contexts, between 'dou' and conjunction/additive words for VPs such as 'ye' "also, and", 'you' "also, again", and 'hai' "also, still".

One would hope that our investigation of the seemingly complex facts reveals the inner workings of distributive universal quantification in both English and Chinese, and the relation between quantification and the event argument in Chinese. In particular, we hope to capture the semantic properties of 'dou' along this line of research. To do so, we would like to start by doing away with the notion that 'dou' is a universal quantifier, which is the predominant view in the literature. To that, we turn.

1.2. Overview of the Literature on 'Dou'

Recently, a considerable amount of work has been devoted to the analysis of '*dou*' by Chinese linguists (Lee (1986), F.-H. Liu (1990), Chiu (1990, 1993), Cheng (1991, 1995), Y.-H. A. Li (1992), J. Li (1995), X. Li (1995), S.-Z. Huang (1995a), among others). All the authors share the view that '*dou*' is a universal quantifier, except S.-Z. Huang (1995a)¹.

One major argument used to support the claim that '*dou*' is a universal quantifier is that '*dou*' is a distributor (Lee (1986), Y.-H. A. Li (1992), F.-H. Liu (1990), Cheng (1995), J. Li (1995), J.-W. Lin (1996)). One piece of evidence supporting this view involves incompatibility between symmetric predicates and '*dou*' (Lee (1986:57-59)). The relevance of using symmetric predicates to test distributivity of '*dou*' is that this class of predicates do not denote singular individuals; but a distributor has the unique role of distributing the property the predicate stands for to singular individuals in the NP denotation, thus symmetric predicates and a distributor are incompatible. The following examples involving symmetric predicates (Lakoff and Peters (1969)) show that symmetric predicates are compatible with 'all', but not with 'each', suggesting that 'all' is not a distributor while 'each' is.

- (7) They are all alike/classmates.
- (8) *They are each alike/classmates.

¹ For some pragmatic/semantic accounts of '*dou*', see Mok and Rose (1996) and Jiang (1996). Both accounts argue against a quantifier analysis of '*dou*'. C.-T. J. Huang (1982:211) calls '*dou*' a scope adverb; see Hsieh (1995) for a similar idea.

Lee considers 'dou' as incompatible with symmetric predicates, but the examples below show that 'dou' is perfectly fine with the Chinese equivalents of the above predicates:

- (9) *tamendou hen xiangxiang/dou shi tongxue.*
they dou very alike /dou be classmate
"They are all alike/all classmates."

If 'dou' were like the distributor 'each', it should have been incompatible with the symmetric predicates. What (9) reveals is that 'dou' is not a distributor. We argued in S.-Z. Huang (1995a) that what is relevant for 'dou' is whether there is a plurality of events. In the above examples, in order for 'all'/'dou' to be used, the plural pronoun has to denote a set of at least three people. Let's say, it is a set made up by Harry, Joe, and Mary. The entailment of the sentence with the symmetric predicate 'alike' is that Harry and Joe are alike, Joe and Mary are alike, and Mary and Harry are alike, not Harry is alike, Joe is alike, and Mary is alike.

On the other hand, if we change the number of individuals in the set of the subject denotation to two, namely the plural pronoun refers to Harry and Mary for English, and Zhangsan and Lisi for Chinese, we see that the sentences are not acceptable with 'all'/'dou' (we consider 'both' a variant of 'all' in that 'both' requires a set with the exact cardinality of two):

- (10) *Harry and Mary are both alike.
- (11) **Zhangsan he Lisi dou hen xiangxiang.*
Zhangsan and Lisi dou very alike
"*Zhangsan and Lisi are both alike."

Even though there are two individuals in the subject, due to the nature of the symmetric predicate used here, there can be only one alike-event in this type of sentence. Thus, 'both'/'dou' cannot be used. However, if we replace 'alike' with the distributive predicate 'smart', the use of 'both'/'dou' becomes fine:

- (12) Harry and Mary are both smart.
- (13) *Zhangsan he Lisi dou hen congming.*
Zhangsan and Lisi dou very smart
"Zhangsan and Lisi are both smart."

This is because there are two events here, at e_i , 'Harry is smart' is true and at event $_j$, 'Mary is smart' is true. Thus, the plurality requirement on the events imposed by 'both' and 'dou' is met.

The above data makes it clear that 'dou' is not a distributor, at least not in the conventional sense used to define 'each', since VP-'each' cannot replace VP-'all' in (7), nor can adverbial 'ge' "each" replace 'dou' in sentences containing symmetric predicates in Chinese, suggesting that VP-'each' and VP-'ge' are true distributors. Drawing on these facts, we concluded in (S.-Z. Huang (1995a)) that 'dou' cannot be equated with

'each' as a distributor. If distributivity is used as evidence for the universal quantifier status of 'dou', then that argument does not hold against (9).

Further more, we noted in S.-Z. Huang (1995a) that 'dou' could be used in sentences where there is no hint of universal quantification reading. Take (14) for example:

- (14) *Zhangsan xue Zhongwen dou xue le san nian le.*
Zhangsan study Chinese dou study LE three year LE
"Zhangsan has studied Chinese for three years."

The subject in (14) is a singular proper name, and there is no universal quantification either on the subject or on the object, or on the events; yet 'dou' is used in this sentence. Any universal quantifier analysis of 'dou' will find this sentence a counterexample.

Another problem we see in the literature on 'dou' has to do with double quantification. If 'dou' is a universal quantifier, it is not clear how and why it quantifies over NPs that already have a universal quantifier determiner as shown in (2) and (3). Even if one adopts the view that 'dou' is an unselective adverbial quantifier, it is well known that unselective adverbial quantifiers only quantify over free variables (Lewis (1975)); NPs with their own quantifier determiners, such as 'meiyige' "every", do not posit a free variable, thus they cannot be quantified by other quantifiers.

In S.-Z. Huang (1995a), we argued that 'dou' is an existential

quantifier that binds an event variable introduced by a plural predicate; the variable ranges over events described by the plural predicate so that all the 'mei' sentences achieve is a reading that for every x there is y.

In this dissertation, we will abandon the claim that 'dou' is an existential quantifier; if it were an existential quantifier, it would have been a very peculiar one. For one thing, no other existential quantifiers in any other language have been found to have such a strong affinity with universal quantifiers (almost required in the scope of a universal quantifier). However, we want to stress that all the empirical observations about 'dou' that we made in S.-Z. Huang (1995a), particularly the notion that in all the 'dou' sentences, what is crucial is that the event argument denotes more than one event, remains to be the driving force for our new semantic account of 'dou'. Furthermore, what we find intuitively right is the observation behind our existential quantifier account of 'dou' that when 'every' or 'mei' is used, there is always a paired reading such that 'Every child smiled' means that for every child there is an event such that the child smiled in that event, and 'dou' facilitates the paired reading in some crucial way.

1.3. Sketch of the Proposed Analysis

The first goal of this thesis is to capture the paired reading intrinsic to distributive universal quantifiers by redefining EVERY, which stands for any distributive universal quantifier, in terms of an associated

skolem function. We start from the more recent development in the generalized quantifier theory that treats determiners like 'every' to denote binary relations (Cooper (1987); van Benthem (1986)), and argue for a modification in the formal translation of 'every' so that the two arguments of EVERY can be paired up through a formal mechanism. The postulation of an event argument (Davidson (1966), Kroch (1974)) in a sentence is essential for our analysis to be applied successfully in English and Chinese.

Our second goal is to provide a semantic account of 'dou', which is closely associated with 'mei', a distributive universal quantifier in Chinese, and argue that it is an adverb that is not a universal quantifier itself, contrary to the prevailing view in the literature. Specifically, we argue that 'dou' is a sum operator that takes the event variable to be its argument. Being a sum operator on events, 'dou' makes the predicate it modifies assert a plurality of minimum events. The size of a minimum event is compatible with the semantics of the predicate, so that 'dou' can modify distributive (e.g. PREGNANT), symmetric (e.g. MEET, ALIKE), and collective (e.g. SURROUND, COLLIDE) predicates. Whether or not the subject of 'dou VP' is a plural noun or not is inconsequential. Furthermore, the sum operation on events results in a maximal plural event that the 'dou VP' takes as an argument. We stipulate that this plural event the predicate is associated with requires that the subject denotation stand in a less than or equal to relation to the predicate denotation, in other words, there is a partial order between the two sets. This will explain not only why 'dou VP' can take NPs with universal

quantifier determiners, but also NPs with determiners such as 'dabufen' "most", 'henduo' "many", plural NPs, conjunction of definite NPs, 'lian NP' "even NP", as well as singular subjects where universal quantification reading does not obtain. All these constituents can enter into the partial order relation with the 'dou VP'. Those NPs, such as 'a man and a woman' may be plural but cannot be predicated on by 'dou VP' because they are NPs that cannot enter the partial order relation due to their intrinsic semantic properties.

Another major hypothesis made in this dissertation is one we first postulated in S.-Z. Huang (1995a,b) where we argued that the co-occurrence pattern between 'mei' and 'dou' is a manifestation of 'dou' serving a function that tense operator serves in English. Details aside, our main contention is that whatever unique function indefinites, reflexives, and 'dou' serve in a sentence with a 'mei' noun phrase, it can be performed by tense in English. Since tense is omnipresent in English, one does not observe similar preference of these items by 'every'. In Chinese, while systematic tense marking is absent, other devices are resorted to. In this thesis, we have identified the function that 'dou' and the tense operator in English share to be the role of an event variable licenser.

One important aspect of this notion of relating 'dou' to tense in English (although not identifying one with the other) is that although one may see the similarity between 'dou' and VP-'all', the former has a far wider distribution than the latter. Thus, assimilating 'dou' to VP-'all', as Chiu (1990, 1993) does, only captures part of the story.

1.4. Organization of the Dissertation

Chapter 2 provides our formal definition of EVERY. After applying the definition to both 'every' and 'mei', we consider a number of issues in Chinese that this skolemized definition of EVERY can shed some light on, i.e., issues such as optionality of 'dou' in the scope of 'mei' and scope ambiguity. Both can be predicted by the proposed account of EVERY and 'dou'.

On the latter issue, we believe that lack of scope ambiguity in Chinese is basically true (S.-F. Huang (1981), C.-T. J. Huang (1982) among others), in contrast to English which allows a set of scope readjustment rules that allow for scope orders different from the surface scope orders (Kroch (1974)). However, we show that there is a limited flexibility for scope ambiguity in Chinese, and the conditions under which this occurs follow from our account of the relation between 'mei' and 'dou' under the skolemized definition of distributive universal quantification. Notably, our account of the scope ambiguity encompasses the case of ambiguity in passive constructions that Aoun and Li (1989) observe.

Chapter 3 takes on the task of laying out in further detail the semantics of 'dou' as a sum operator on events. We basically adopt Lasnik's lattice theoretic definition of sum of events to provide precision to our discussion. One prediction this proposed account of 'dou' makes is that as a sum operator, 'dou' should not be restricted to appear in the scope of universal quantifiers nor be associated with

universal quantification interpretation only. As evidence will show, this prediction is indeed borne out.

We are particularly interested in how the sum operation on the event variable will affect the predication relation in the sentence. We hypothesize that 'dou PRED' is always in a partial order relation with its argument. This hypothesis is supported by facts ranging from sentences showing universal quantification reading to sentences where such a reading is absent, including the relation between 'dou' and a wh-phrase to its right, suggesting that 'dou' is not a universal quantifier, but its distribution encompasses the cases in which universal quantification obtains.

As a sum operator on events, the interchangeability, in a number of contexts, between 'dou' and a group of adverbs such as 'ye' "also, and", 'you' "also, again", and 'hai' "also, still" can be explained straightforwardly without claiming that these are all universal quantifiers--the members in the latter group are, as we will argue, all sum operators on events semantically while functioning as conjunction or additive words for VPs syntactically.

In Chapter 4, we consider the wider implication of the stipulation made in Chapter 2 that only morphologically or lexically licensed variables are available for interpretation. Starting from Parsons's theory on constraining the event variable, we argue that event variable licensing, as 'dou' has been shown to do, can be generalized to event variable constraining, which we put into the Hypothesis on Constraining the Eventuality Argument (HCEA). This hypothesis is then tested first in

the case of existential quantification and then universal quantification of the event variable. In both cases, we show that a number of apparently disparate phenomena in Chinese can be brought under the rubric of event argument constraining. Most notably, we show that what has been widely perceived as a resistance to indefinite subjects in Chinese can be actually explained by our HCEA. The focus of the investigation is shifted from the subject to the predicate. Evidence is provided to support our argument that the indefinite subjects are not causes that lead to unacceptability--they are always bound by existential closure; it is having an unconstrained event variable that creates problems for the sentence because, when unconstrained, the event variable cannot be existentially bound.

We then consider a number of conditional sentences in which universal quantification of event variables is involved. HCEA allows us to account for the use of 'dou' and 'jiu' in these sentences as lexical constrainers of the event variable. A very nice piece of evidence supporting our HCEA comes from cases where 'jiu' is optional in the conditional sentence. We show that this is possible in precisely those contexts in which the event variable is not needed for skolemization, which is exactly the same condition under which 'dou' is optional.

A part of Chapter 4 is devoted to a systematic examination of five major classes of adverbial modifiers and to see if they can function as constrainers of the event variable. These five classes are:

I. Speech-Act Modifiers

- II. Sentence Modifiers
- III. Subject-Oriented Modifiers
- IV. VP Modifiers
- V. Other

This classification is based on Parsons (1990:62-64), who adopted it from Jackendoff (1972) and Bellert (1977). All five classes are found to have at least some members that can be argued to lexically constrain the event variable. Findings in Chapter 4 strengthen our contention that in Chinese, 'dou' is not an isolated phenomenon in terms of acting as a constrainer on the event variable. It is part of a prevalent pattern which is attributable to the absence of tense in this language.

Chapter 2

EVERY and Skolemization

Consider the sentence:

- (1) Every man kissed a woman.

In the more recent treatments of quantifier determiners under the theory of generalized quantifiers, the English quantifier 'every' as used in (1) is modeled as a relation between two sets, the first denoted by the subject and the second by the predicate, as defined in (2) (Cooper (1987), van Benthem (1986)).

- (2) 'EVERY (P, Q)' is true iff P is a subset of Q.

If we model the English quantifier 'every' in this way, we are saying that sentence (1) is true if and only if the set of men is a subset of the set of woman-kissers.

2.1. 'Every' and Skolemization

It is argued in this dissertation, however, that part of the meaning of (1) is that for every man there is a woman such that the man

kissed the woman; that is, the sentence conveys the sense that there is a list of pairs, each of which consists of a man and a woman in that order, such that a certain relation holds between the members of the pair, in this case the kissing relation. This aspect of the meaning of the natural language expression 'every' is not directly reflected in the formal model of universal quantification given in (2).

In fact, (2) is not sufficient for interpreting the universal quantifier word 'all' either. In the following sentence, discussed in Kroch (1974), 'all' is not a relational term as modeled in (2):

(3) All of the boys left together.

If (2) were the right model for the interpretation of 'all' in this sentence, (3) would be translated into a logical form in which 'left together' would be true of each boy, which is not and cannot be the meaning of (3), because 'left together' can only be true of plural individuals (Link (1983), Landman (1991)).

The right interpretation of (3) is that there was an event of 'leaving together' and a contextually determined set of boys participated in that event and the function of 'all' is to exhaust the membership in the group of boys so that no boys are left out (Kroch 1974).

This aspect of 'all' is definitely outside the range of meanings the model in (2) will capture, and a more elaborate formal model for universal quantification would have to be composed to reflect the semantics of 'all'. In this dissertation, we will concentrate on enriching

the formal model to better represent 'every' and leave the issues concerning 'all' aside except when relevant to our immediate concerns.

To capture formally the pairing imposed by 'every', we propose that the definition of its formal translation be augmented by relating its two arguments via a skolem function. A skolem function links two variables by making the choice of a value for one variable depend on the choice of a value for the other. Using a skolem function, we can construct the second argument of EVERY from the first out of the pairings that the function provides. Thus, we can rewrite (2) as (4).

(4) 'EVERY (P, f (P))' is true iff P is a subset of f (P), where f (P) is constructed from P by an appropriate total skolem function f .

Let us assume, with Kamp (1981) and Heim (1982), that indefinite noun phrases correspond to variables in logical form. Then, using the definition in (4), we can give (5) as the formal translation of (1) by substituting a skolem function for the variable corresponding to 'a woman'.

(5) EVERY ($\{x \mid \text{MAN}(x)\}, \{y \mid \text{KISSED}(y, f(x)) \wedge \text{WOMAN}(f(x))\}$),
where f is a function that maps men onto women.

Here the set P of our definition is $\{x \mid \text{MAN}(x)\}$ and the set f(P) is

$\{y \mid \text{KISSED}(y, f(x)) \wedge \text{WOMAN}(f(x))\}$. For each x in P we get a paired $f(x)$, which determines through the formula 'KISSED($y, f(x)$)' part of the membership of the set $f(P)$.

Another illustration of the usefulness of skolemization in our definition is given by reflexive pronouns bound by 'every' noun phrases. Reflexive pronouns can be viewed as variables restricted by a function that sets them equal to the variable in the position of their antecedents so that a predicate like 'shave oneself' would have the representation in (6).

$$(6) \quad \{y \mid \text{SHAVE}(y, z) \wedge z=y\}$$

So then under the definition of EVERY in (4), (7) will have (8) as its logical form.

(7) Every man shaved himself.

$$(8) \quad \text{EVERY}(\{x \mid \text{MAN}(x)\}, \{y \mid \text{SHAVE}(y, f(x)) \wedge f(x) = y\})$$

Here the appropriate skolem function $f(x)$ is the identity function and it replaces the variable associated with the reflexive. (8) says that the choices of values for x , call them x_1, x_2, x_3, \dots , and x_{n+1} , determine the choices of values for $f(x)$, call them $f(x_1), f(x_2), f(x_3), \dots$, and $f(x_{n+1})$. For y shaved $f(x_1)$, y shaved $f(x_2)$, y shaved $f(x_3)$, ..., and y shaved $f(x_{n+1})$, we get y_1, y_2, y_3, \dots , and y_{n+1} . By the second conjunct characterizing $\{y\}$, we get $f(x_1) = y_1, f(x_2) = y_2$, and so on. So in fact, the two arguments of EVERY

are identical sets and we get the correct truth conditions for (6) by pairing every man with himself.

Our skolemized definition of EVERY can be applied to more cases than just those sentences where the predicates contain overt variables. If, as we believe, pairing is an integral part of the meaning of 'every', skolemization should always be used in the formal translation of sentences in which 'every' appears. To be able to use our skolemized definition for the general case, then, we must be sure that there will always be a variable available within the predicate of a sentence with an 'every' noun phrase subject.

To have a variable within the predicate is not a problem if we adopt that view that predicates contain event variables (Davidson (1966), Kroch (1974)). We would like to stipulate that the event argument e is introduced by a function we call $AT()$, which restricts the truth of the sentence to e . For instance, the translation of (9) is (10):

(9) John left.

(10) $AT(\text{LEAVE}(\text{John}, e_j) \wedge T(e_j) \text{ BEFORE } t_{\text{now}})$, where T is the tense operator and maps events onto times.

(10) means that 'John leave' is true of e_j and the time of e_j is before now. The second conjunct in (10) is the contribution of the past tense morpheme.

A sentence with an 'every' noun phrase subject like (11) can now be translated as (12), with a skolemized event variable.

(11) Every boy left.

(12) EVERY ($\{x \mid \text{BOY}(x)\}, \{y \mid \text{AT}(\text{LEAVE}(y, f(x))) \wedge \text{T}(f(x))$
BEFORE $t_{\text{now}}\}$)

Because in (12), $f(x)$ replaces the event variable, every boy is paired with an event of leaving, and each such event took place before now. This captures the implicit distributivity of (11), which is demonstrated by its compatibility with a distributive adverb like 'separately' and its incompatibility with a collective adverb like 'together' (Kroch (1974)).

(13) Every boy left separately.

(14) *Every boy left together.

2.1.1. Choosing the Appropriate Skolem Function

In all of the illustrations above, we have proceeded under the assumption that the skolem function f we choose is the appropriate one. In reality, there are many skolem functions we could have chosen that would not have given the correct truth conditions for our examples. Returning to sentence (1), we clearly cannot choose just any skolem function f that pairs men with women, if we want to capture the truth

conditions of (1). If (1) is false, then no choice of f will make its formal translation in (5) true; but if (1) is true, there are many choices of f for which (5) will be false. For example, if f pairs every man with Mother Teresa, then (5) will be false even in contexts where (1) is true. Another way in which things may go wrong is the following. If a man is paired with a woman who is kissed but by individuals other than the man, then the predicate will denote an individual or individuals other than the man, and x will not be a member of $\{y\}$. So again this skolem function is not the right one. To handle these cases, we want to say in our definition of EVERY that if a sentence like (1) is true, we will always be able to find at least one choice of a skolem function f such that the translation of the sentence, here (5), will be true using that f .

The next question is how to choose the right skolem function among those that generate pairings that create a truth conditionally appropriate set as the second argument of EVERY. For example, suppose there are three men in the universe and they are John, Bill, and Sam. Then (15) entails (16):

(15) Every man left.

(16) (John left) \wedge (Bill left) \wedge (Sam left)

(16) can be represented as (17).

(17) $(\text{AT}(\text{LEAVE}(\text{John}, e_j)) \wedge T(e_j) \text{ BEFORE } t_{\text{now}}) \wedge (\text{AT}(\text{LEAVE}(\text{Bill}, e_b)) \wedge T(e_b) \text{ BEFORE } t_{\text{now}}) \wedge (\text{AT}(\text{LEAVE}(\text{Sam}, e_s)) \wedge T(e_s) \text{ BEFORE } t_{\text{now}})$

The obvious skolem function to use in representing (15) is the one that pairs each man with the event in which he left, let us call it f_r , which we can represent as the following list of pairs.

(18) $\langle \text{John}, e_j \rangle, \langle \text{Bill}, e_b \rangle, \text{ and } \langle \text{Sam}, e_s \rangle$

From this pairing, we can construct the second argument of EVERY. But the situation is more complicated than this. We can also construct the second argument set in such a way that captures the truth conditions of the sentence with a skolem function that pairs men and leaving events in an unnatural way. Let f_w be a skolem function that makes the following pairings.

(19) $\langle \text{John}, e_b \rangle, \langle \text{Bill}, e_s \rangle, \text{ and } \langle \text{Sam}, e_j \rangle$

Then $\text{AT}(\text{LEAVE}(y, e_b))$ will denote Bill, and $\text{AT}(\text{LEAVE}(y, e_s))$ will denote Sam, and $\text{AT}(\text{LEAVE}(y, e_j))$ will denote John. As a result, the first argument of EVERY would be the set $\{\text{John}, \text{Bill}, \text{Sam}\}$; and if sentence (15) is true in the context we are discussing, the second argument of EVERY will also be the set $\{\text{John}, \text{Bill}, \text{Sam}\}$. Thus, a logical translation of (15) using f_w will come out as true despite the unnaturalness of the

pairings given by f_w . John is paired with an event e_b that he has nothing to do with and the same can be said about the other two men, so these pairings give the right truth value for the sentence by accident. Therefore, we must place further restrictions on our definition of EVERY to limit the skolem functions that it accepts.

Note that although f_w would create the correct second argument of EVERY, a second argument constructed from a subset of the men will be incorrect. Let us take the subset {John, Bill} for example. Because John and Bill are paired with e_b and e_s by f_w , the set that AT (LEAVE (y , e_b)) and AT (LEAVE (y , e_s)) denotes is {Bill, Sam}, and {John, Bill} is not a subset of {Bill, Sam}. This is in contrast to what would happen if we used f_r to construct the second set. With f_r we are guaranteed that for any P' , $P' \subseteq P$, if EVERY(P , $f(P)$) then EVERY(P' , $f(P')$).

To illustrate, let $P = \{x: \text{John, Bill, Sam}\}$ and f_r give the pairings in (18). If we take $P' \subseteq P$ to be {John}, then $f_r(\text{John}) = e_j$, and $f_r(P') = \{y \mid \text{AT}(\text{LEAVE } (y, e_j))\} = \{\text{John}\}$. Now, if we let $P' = \{\text{John, Bill}\}$ then $f_r(\text{John}) = e_j$ and $f_r(\text{Bill}) = e_b$, and $f_r(P') = \{y \mid \text{AT}(\text{LEAVE } (y, e_j)) \text{ or } \text{AT}(\text{LEAVE } (y, e_b))\} = \{\text{John, Bill}\}$. The same is true for all other cases. In other words, when a sentence like (15) is true, if we take any $P' \subseteq P$, then $P' \subseteq f(P')$. This means that if we change the definition of EVERY so that it requires giving the correct truth conditions for subsets of its first argument, it will distinguish the skolem function that generates the natural pairings from those that do not. Thus, we revise (4) as in (20).

(20) EVERY ($P, f(P)$) is true iff for every $P' \subseteq P$, P' is a subset of $f(P')$, where $f(P)$ is constructed from P by a total skolem function.

Our new definition of EVERY has an additional useful consequence. It formally reflects the distributivity of the natural language quantifier 'every'. Since subsets can be constituted by single individual members of the superset, in any sentence modeled by (20) the natural language predicate used in constructing the set $f(P)$ must be semantically of a type which can take the individual members of the set P as its argument; and further the sentence will be true if and only if the predicate holds of each of these individual members of P . This is just the distributivity that 'every' exhibits.

2.1.2. *Scope Ambiguity in English*

Our revised definition of EVERY handles scope ambiguities in a straightforward way, if we add the operation of existential closure to our logical form translations and introduce the existential quantifier in a wide scope position (Heim 1982). This is necessary because the pairing created by the skolem function introduced by EVERY produces a narrow scope interpretation of an indefinite noun phrase when the associated variable is skolemized. Thus, (5) is the logical translation of (1) that gives a narrow scope reading of the indefinite noun phrase 'a woman'; and (21)

below is the logical translation that gives a wide scope reading of the same phrase:

$$(21) \quad (\exists z) (\text{EVERY} (\{x \mid \text{MAN}(x)\}, \{y \mid \text{AT}(\text{KISS}(y, z, f(x))) \wedge \text{WOMAN}(z) \wedge T(f(x)) \text{ BEFORE } t_{\text{now}}\}))$$

Here the variable introduced by 'a woman' is bound off by the existential closure on the outside of the formula and the event variable is skolemized. Therefore, each man is paired with a kissing event that involves the same woman.

Obviously, it is the fact that we have two variables at our disposal in (1) that makes the account of scope ambiguities based on our skolemized definition of EVERY work. To be consistent then, we will modify (5) as (5)' so that the event variable is included in the logical translation.

$$(5)' \quad (\exists e) (\text{EVERY} (\{x \mid \text{MAN}(x)\}, \{y \mid \text{AT}(\text{KISSED}(y, f(x), e)) \wedge \text{WOMAN}(f(x)) \wedge T(e) \text{ BEFORE } t_{\text{now}}\})),$$

where f is a function that maps men onto women.

For this logical translation to be true, the event variable has to range over plural events. The notion of plural events is analogous to the notion of plural individuals: In our ontology, there are singular individuals that have no other individuals as their subparts, and there are plural individuals that are sums of singular individuals (Link 1983; Landman

1991). We believe that just like individuals, events come in two sizes, singular events and plural events, where a plural event is a sum of singular events. Under this assumption, to have the event variable existentially quantified outside the scope of 'every' is not a problem--(5) simply means that there is a sum of events and for every man there is a woman such that the man kissed the woman in this plural event that took place in the past.

Our skolemized definition of EVERY, including the above account of scope ambiguities, applies without alteration to sentences where an 'every' noun phrase appears in the object position, as we can see below.

(22) A man kissed every woman

a. $(\exists z) (\text{EVERY} (\{ x \mid \text{WOMAN}(x) \}, \{ y \mid \text{AT}(\text{KISS}(z, y, f(x))) \wedge \text{MAN}(z) \wedge \text{T}(f(x)) \text{ BEFORE } t_{\text{now}} \}))$

b. $(\exists e) (\text{EVERY} (\{ x \mid \text{WOMAN}(x) \}, \{ y \mid \text{AT}(\text{KISS}(f(x), y, e)) \wedge \text{MAN}(f(x)) \wedge \text{T}(e) \text{ BEFORE } t_{\text{now}} \}))$

In (22a) we have skolemized the event variable and bound off the variable associated with the indefinite by existential closure, yielding a wide scope interpretation for the indefinite, while in (22b) we have bound off the event variable by existential closure outside EVERY and skolemized the variable from the indefinite, yielding the narrow scope reading of 'a man'.

Thus, (22a) says that there is a man such that for every woman there is an event in which she was kissed by this man, and (22b) says that there is a plural event and for every woman there is a man and the man kissed her in that plural event.

2.1.3. One Sentence with Two Universal Quantifiers

Next, let us consider a sentence like (23):

(23) Every boy kissed every girl.

This sentence differs from the previous sentences in that there are two 'every' noun phrases in one sentence. The interpretation of such a sentence under the generalized quantifier theory is that the set of boys is a subset of the set of individuals who kissed every girl or, equivalently, the set of girls is a subset of the set of individuals who were kissed by every boy. We give these translations below for reference:

(24) (a) EVERY ($\{x \mid \text{BOY}(x)\}, \{y \mid \text{EVERY}(\{z \mid \text{GIRL}(z)\}, \{w \mid \text{KISSED}(y, w)\})\}$)

(b) EVERY ($\{z \mid \text{GIRL}(z)\}, \{w \mid \text{EVERY}(\{x \mid \text{BOY}(x)\}, \{y \mid \text{KISSED}(y, w)\})\}$)

But in modeling 'every' after EVERY as defined in (20), we require that both 'every's be associated with a skolem function. The problem is there is only one event variable but two 'every' noun phrases. However, we will see, after some examination of the sentence, that this problem is easily resolved.

Recall that what a skolem function accomplishes for EVERY is to construct the second argument of EVERY from the first out of the pairings it generates. In a sentence with two 'every' noun phrases, it is then clear that two sets need to be constructed under skolemization. The question is whether they are constructed independently of each other or not.

To understand what is at issue here, let us look at two simple sentences as given below:

(25) Every boy left.

(26) EVERY ($\{ x \mid \text{BOY}(x) \}$, $\{ y \mid \text{AT}(\text{LEAVE}(y, f(x))) \wedge T(f(x))$
BEFORE $t_{\text{now}} \}$)

(27) John kissed every girl.

(28) EVERY ($\{ z \mid \text{GIRL}(z) \}$, $\{ w \mid \text{AT}(\text{KISS}(\text{John}, w, f(e)) \wedge T(f(e))$
BEFORE $t_{\text{now}} \}$)

In both sentences, a skolem function links the two arguments of EVERY by constructing the second one from the first by skolemizing the event variable. We can see that once the value of the event variable is chosen,

the value of y and w can be chosen through the open formula 'AT (LEAVE ($y, f(x)$) \wedge T($f(x)$) BEFORE t_{now})' and 'AT(KISS (John, $w, f(e)$ \wedge T($f(e)$) BEFORE t_{now})', respectively. Note that the two formulas each have one unbound variable, and the predicates in the formula are characteristic functions of the sets, picking out those individuals of whom the formulas hold true.

In contrast, in (24a) for example, $\{y\}$, the second argument of EVERY from 'every boy', and $\{w\}$, the second argument of EVERY from 'every girl', are constructed from a single formula and this formula has two unbound variables (abstracting away from irrelevant details, this formula has the form 'y kissed w'), which means it is impossible to construct $\{y\}$ and $\{w\}$ independently of each other since a formula with two unbound variables cannot apply to an entity to yield a truth value.

The obvious conclusion to draw is that $\{y\}$ and $\{w\}$ have to be constructed simultaneously. From observing the procedures in the simple sentences, we know that $\{y\}$ should be constructed based on the choices in $\{x\}$ and $\{w\}$ on the choices in $\{z\}$. To simultaneously construct $\{y\}$ and $\{w\}$, we need to decide on the values of x and z simultaneously too and skolemize the event variable based on the two choices.

What is the relation between the two values then? Given the positions of 'every boy' and 'every girl' in the sentence, we know that one is the agent and the other is the patient of a single action. Thus, they must form an ordered pair $\langle x, z \rangle$ so that the kissing relation holds between them. Now we can pair this pair with an event under a skolem function f , so we get $f(\langle x, z \rangle)$. This skolem function maps a pair of

entities onto an event. Thus, we solve the problem of having only one variable--there is no more competition from two different skolem functions for the same variable; instead the first arguments of the two EVERY's now serve as sources for the two members of an ordered pair which f takes as its argument.

Just as x in $f(x)$ comes from $\{x\}$, $\langle x, z \rangle$ in $f(\langle x, z \rangle)$ comes from $\{\langle x, z \rangle\}$, and this set is the Cartesian product of the sets of boys and girls, the Cartesian product of A and B is defined as:

$$(29) \quad A \times B = \{ \langle a, b \rangle : a \text{ a member of } A \wedge b \text{ a member of } B \}$$

This pairing between x and z shows that each boy is paired with each girl. To see this clearly, let us take an example in which there are three boys in the boy set--Johnny, Billy, and Sammy, and four girls in the girl set--Kathy, Mary, Nancy, and Sally. The Cartesian product of the two sets, $\{x\} \times \{z\}$ is a set of twelve pairs:

$$(30) \quad \{x\} \times \{z\} = \{ \langle x, z \rangle : \langle \text{Johnny, Kathy} \rangle, \langle \text{Johnny, Mary} \rangle, \langle \text{Johnny, Nancy} \rangle, \langle \text{Johnny, Sally} \rangle, \langle \text{Billy, Kathy} \rangle, \langle \text{Billy, Mary} \rangle, \langle \text{Billy, Nancy} \rangle, \langle \text{Billy, Sally} \rangle, \langle \text{Sammy, Kathy} \rangle, \langle \text{Sammy, Mary} \rangle, \langle \text{Sammy, Nancy} \rangle, \langle \text{Sammy, Sally} \rangle \}$$

Now $f(\langle \text{Johnny, Kathy} \rangle) = e_{j+k}$, $f(\langle \text{Johnny, Mary} \rangle) = e_{j+m}$, and so on. When we substitute this $f(\langle x, z \rangle)$ into the logical translation for the event variable, we should get the correct truth conditions for (23), namely we

should be able to construct $\{y\}$ and $\{w\}$ simultaneously and get the correct truth conditions.

The following are the two equivalent logical translations of (23) based on our skolemized definition of EVERY:

- (31) a. EVERY ($\{x \mid \text{BOY}(x)\}$, $\{y \mid \text{EVERY}(\{z \mid \text{GIRL}(z)\},$
 $\{w \mid \text{AT}(\text{KISS}(y, w, f(\langle x, z \rangle)) \wedge T(f(\langle x, z \rangle)) \text{ BEFORE } t_{\text{now}})\}$)
- b. EVERY ($\{z \mid \text{GIRL}(z)\}$, $\{w \mid \text{EVERY}(\{x \mid \text{BOY}(x)\},$
 $\{y \mid \text{AT}(\text{KISS}(y, w, f(\langle x, z \rangle)) \wedge T(f(\langle x, z \rangle)) \text{ BEFORE } t_{\text{now}})\}$)

2.2. Chinese 'Mei' "every"

In this section, we argue that the skolemized definition of EVERY applies as readily to the Chinese quantifier determiner 'mei' as to the English quantifier determiner 'every'. We will illustrate this claim first with 'mei'-sentences with an indefinite object and with a reflexive. Then we will discuss the more interesting case, where the skolemized variable is the event variable. We will show that the skolemized definition of EVERY not only applies across the two languages, as expected, but more importantly it helps us understand some of the phenomena in Chinese in a new light.

2.2.1. 'Mei'...Indefinites

(32) is a sentence with a 'mei' noun phrase in the subject position and an indefinite in the object position and (33) is the logical translation based on our skolemized definition of EVERY.

(32) *meiyige nuhai chang le yige ge.*
every-MW girl sing LE one-MW song
'Every girl sang a song.'

(33) EVERY ($\{x \mid \text{GIRL}(x)\}, \{y \mid \text{SANG}(y, f(x)) \wedge \text{SONG}(f(x))\}$)

One thing that sets this translation apart from the translation of a similar English sentence is that there is no event variable in the translation or tense. It is well known that Chinese has no systematic tense marking. We will argue that the lack of event variable in the logical translation of (32) is related to that fact and will discuss it in more detail later when discussing skolemization of the event variable. For the time being, however, there is no problem as far as modeling 'mei' as EVERY with a skolem function is concerned because the indefinite noun phrase provides a variable for skolemization. (33) says that for every girl in the set $\{x\}$, an appropriate skolem function can pick out a song to pair with the girl such that the girl sang the song. Since the value for $f(x)$ changes according to x , we construct $\{y\}$.

2.2.2. *'Mei'...Reflexives*

If the predicate contains a reflexive, we would have (35) as the logical translation of (34) ((34) is repeated here from the previous section):

- (34) *meiyige houxuanren tan-le-tan ziji.*
every-MW candidate talk-LE-talkself.
'Every candidate talked about himself/herself.'

- (35) EVERY ($\{x \mid \text{CANDIDATE}(x)\}, \{y \mid \text{TALKED-ABOUT}(y, f(x)) \wedge f(x) = y\}$)

The skolem function replaces the variable introduced by the reflexive, and we can construct a set of individuals who introduced $f(x)$.

2.2.3. *'Mei'... Event Variable*

Now let us see how our skolemized definition of EVERY works with a sentence in which the event variable is needed for skolemization. (36) shows that there are some complications when there is no overt variable in the predicate for skolemization:

(36) **meiyige xuesheng xihuan zheibenshu.*
every-ME student like this-ME book

Intended meaning: 'Every student likes this book.'

We claim that the reason why (36) is ungrammatical is that no variable is available for skolemization by 'mei' in this sentence. This claim immediately raises the question of why the event variable, which ought to be available in all languages, cannot be used for skolemization in Chinese sentences like (36). To address this question we must make an observation about the effect of the implicit variable vs. the explicit variable in the semantic interpretation of a sentence and show how the generalization accounts for why an event variable is not always available for skolemization.

It is well known that transitive verbs like 'eat' can appear without an overt object, but semantically there is an implicit argument if the object is left out. Thus, 'Mary ate' means 'Mary ate something'. The same is true in Chinese. One can say both (37) and (38):

(37) *Lisi chi le yige pingguo.*

Lisi eatLE one-MW apple

'Lisi ate an apple.'

(38) *Lisi chile.*

Lisi ateLE

'Lisi ate.'

However, the implicit argument in the object position is not available for skolemization. So even though (39) is fine, (40) is not:

(39) *meiyige houzi chi le yige xiangjiao.*
every-MW monkey eatLE one-MW banana
'Every monkey ate a banana.'

(40) **meiyige houzi chi le.*
every-MW monkey eatLE
'Every monkey ate.'

A similar contrast can be found in English. The English quantifier 'each' seems to require, if the sentence in which it appears is to sound entirely natural, that the skolemized variable in logical form correspond to a lexically overt expression in the surface sentence. Compare (41) and (42):

(41) ??Each woman fell asleep.

(42) Each woman fell asleep on a soft bed.

Just as in Chinese the implicit argument of a transitive verb used intransitively does not provide a variable for skolemization:

(43) ?? Each woman ate.

Given the facts of Chinese and English, we make the following assumption. There are two stages of interpretation with regard to variables. At the first stage, only morphologically and lexically overt elements in the sentence get translated as variables. At the second stage, those positions that are empty but necessary for full semantic interpretation will be filled by variables and interpreted. The variable used for skolemization must be available at the first stage of interpretation, since it is part of the logical form translation of the overt items 'every' and 'mei'.

To illustrate, the following two sentences get their interpretation differently.

(44) John ate an apple.

(a) First stage: $(\exists x) (AT(EAT (John, x, e)) \wedge APPLE (x)) \wedge T(e) BEFORE t_{now}$

(45) John ate.

(a) First stage: $(AT(EAT (John, _, e)) \wedge T(e) BEFORE t_{now})$

(b) Second stage: $(\exists x) (AT(EAT (John, x, e)) \wedge T(e) BEFORE t_{now})$

In (44), all the arguments of the predicate 'eat' are present in the sentence, therefore every variable appears at the first stage of interpretation. In contrast, the transitive verb 'eat' does not have all of its arguments available in the lexical forms in (46), thus, at the first stage of

interpretation as in (14a), the second argument slot for 'eat' is unfilled, as indicated by the underline. In (46b), the variable is inserted, and is subsequently bound off by the existential quantifier introduced by the existential closure operation.

We can now see why the event variable in English is available for skolemization while in Chinese it is not. In English the event variable is an argument of the morphologically overt tense operator and as such it is present at the first stage of interpretation. In Chinese, by contrast, the event variable does not correspond to any overt morphology or lexical item; and therefore it is not available at the first stage of interpretation. Since we are modeling 'mei' as EVERY which uses a skolemized variable skolemization is a lexical property of 'mei' and as such should be part of the logical translation at the first stage and, just as with English 'each' cannot wait for the second stage when the event variable is introduced.

The grammatical equivalent of (36) in Chinese is (46), which differs from (39) only in that the word 'dou' introduces the predicate of the sentence.

(46) *meiyige xuesheng dou xihuan zheibenshu.*
every-ME student dou like this-ME book
'Every student likes this book.'

If we can show that 'dou' is an operator that, like tense in English, takes the event variable as its argument, then we can explain why its presence

licenses the use of 'mei': It simply makes the event variable available for skolemization at the first stage of interpretation.

We propose that 'dou' is a sum operator that takes the event variable as its argument. 'Dou PRED' is translated into the logical representation as follows:

$$(47) \quad \{x \mid \text{dou PRED}(x)\} = \{x \mid \text{AT}(\text{PRED}(x, e)) \text{ and } \text{DOU}(e, \text{PRED})\},$$

where $\text{DOU}(e, \text{PRED})$ is true iff e is an event of minimum size consistent with the semantics of PRED ¹.

The size of a minimum event is the size of the minimum argument of its predicate. Thus, if the predicate of a sentence is a verb like 'collide', the minimum size of the associated event variable will be plural, since 'collide' requires a plural argument as its minimum argument; but if the predicate is a verb like 'cry', the minimum size of the associated event variable will be singular, since 'cry' can take a singular argument.

The following considerations support our proposal that the event is of minimum size, which may involve singular or plural individuals as subject argument of the predicates which are true of the minimum events. It is well known that there is a semantic contrast between (48) and (49) due to the presence of 'dou'.

¹ More on the sum operator status of 'dou' in the next chapter.

(48) *Zhangsan he Lisi jieju le wu ge wenti.*

Zhangsan and Lisi solve LE five-MW problem

(49) *Zhangsan he Lisi dou jieju le wu ge wenti.*

Zhangsan and Lisi dou solved LE five-MW problems

(50) a. *Zhangsan and Lisi solved five problems.*

b. Zhangsan and Lisi together solved five problems

c. Zhangsan and Lisi each solved five problems.

Sentence (48) can be translated as in (50a), (50b) or (50c), but sentence (49) has only the interpretation of (50c). Examples like (49) have led to the claim that 'dou' is a distributor like 'each' (Lee (1986), F.-H. Liu (1990), Cheng (1995)). However, upon closer inspection, 'dou' is more like a "minimizer", in a manner of speaking, on the event variable, rather than the traditionally defined "distributor" which distributes the property the predicate stands for to each individual member in the subject denotation set. We have seen in Chapter 1 that 'dou' can modify a symmetric predicate such as 'alike'. We want to further illustrate the compatibility between 'dou' and symmetric predicates in general by using the symmetric predicate 'met yesterday' to drive home this notion. We choose 'meet' for its social meaning, not its business meaning. If $\{a, b, c\} = \{\text{Lao Zhang, Lao Li, Lao Wang}\}$,

- (51) *Lao Zhang, Lao Li, Lao Wang zuotian (dou) jian le mian.*
 Lao Zhang, Lao Li, Lao Wang yesterday (dou)see LE face
 'Lao Zhang, Lao Li, Lao Wang (all) met yesterday.'

A symmetric predicate such as 'meet' requires that each of such minimal events involve a pair of individuals. The presence of 'dou' requires that the predicate denote more than one such minimal event. Suppose that minimal event e_1 denotes meet-yesterday{a, b}, e_2 denotes meet-yesterday{b, c} and e_3 denotes meet-yesterday{c, d}. Then when 'dou' is used in sentence (51), all three of these meetings must have taken place for the sentence to be true. Without 'dou' the sentence can also mean that there was one meeting involving all three participants.

In the above example, the existence of three participants makes it possible to have a maximal event three-way meeting or a series of minimal event two-way meetings. If we reduce the number of participants to two, the distinction between maximal and minimal events is eliminated. Thus, even if there are two individuals in the subject denotation, the 'dou PRED', which normally takes a subject with a cardinality of two and above, cannot be used, as shown in (52). The reason is simple: There are two individuals but only one event.

- (52) *Lao Zhanghe Lao Wang (*dou)jian le mian.*
 Lao Zhang and Lao Wang dou see LE face
 'Lao Zhang and Lao Wang (*both) met.'

In other words, the 'meet yesterday' property is true of a pair of individuals at a single event. The so-called distributivity associated with 'dou' is actually a sub-part of 'dou's full function: It requires that the event be the minimum size consistent with the meaning of the predicate, which entails that the argument set contains individuals that are of the minimum size of which the predicate can be true. In the case of a distributive predicate like 'pregnant', of course this means each individual is a singular individual that has no other individuals as its subpart; in the case of a symmetric predicate like 'alike', the individual is a plural individual that has as its subpart two singular individuals; and in the case of a collective predicate like 'collide' the individual is also a plural individual with two or more singular individuals as its subpart.

In contrast, 'each' distributes over singular individuals only so that (53) is ungrammatical:

(53) *Peter, Paul, and Bill each met yesterday.

In conclusion, 'dou' cannot be equated with 'each'.

In light of the above considerations, the skolem function associated with the interpretation of (47) would map 'every student' onto a minimum event of this-book-liking. Because of the minimum event restriction, the predicate denotes a set of singular individuals. Below is the formal logical translation of (46):

(54) EVERY ($\{x \mid \text{STUDENT}(x)\}, \{y \mid \text{AT}(\text{LIKE-THIS-BOOK}(y, f(x))) \wedge \text{DOU}(f(x), \text{LIKE-THIS-BOOK})\}$)

2.2.4. Scope Ambiguity in Chinese

Kroch (1974) showed that in English there are several components in a system of scope rules; in addition to a general surface ordering principle that gives preference to a scope order that follows the surface order of the operator words, there is a set of scope readjustment rules that allow for scope orders different from the initial one. This account of scope orders gives a certain degree of flexibility to accommodate lexical and structural differences the operator words are associated with but at the same time constrains the scope order possibilities by a few general rules (in other words, scope order among quantifiers is not free). More recent accounts achieve a similar result with the use of quantifier raising at LF (May (1985)).

It has been claimed in the literature that Chinese sentences containing multiple quantifiers or other logical elements are unambiguous as to scope order (S.-F. Huang (1981), C.-T. J. Huang (1982) among others). C.-T. J. Huang, in particular, has argued that Kroch's general surface ordering principle is a version of the traditional idea that scope order assignment in the logical translation should be based on the surface order among quantifier words, and this traditional idea should be incorporated into Universal Grammar; furthermore, the

typological differences among languages such as English and Chinese should be attributed to structural differences, thus making the scope readjustments follow from constraints on phrase structure.

The facts in Chinese examined in the literature do support the general claim that the surface order is usually the only scope order allowed. This is almost always true with respect to the interaction between the quantifier word 'mei' "every" and other operator words such as 'bu'/'mei' "not", 'dei' "must", 'keneng' "can, possibly", etc.². For instance, the following sentence has only one scope reading which is derived from the surface order:

- (55) *meiyige ren dou mei lai.*
every-MW person dou not come
'Everyone didn't come' = 'No one came.'

The other reading 'Not everyone came' is not possible. Therefore, it seems that Chinese differs from English in not allowing scope readjustment³.

There is, however, one problem with this conclusion: Although operator words like the ones listed above do not allow scope readjustments, the scope behavior of indefinite noun phrases is different, a fact not generally recognized in the literature. Consider the sentences in (56):

² For a recent study of scope relations among operator words, see Ernst (1996).

³ Aoun and Li (1989) observe limited scope ambiguity in Chinese, notably in passive sentences, also from a structural point of view. Their data involving passives can be incorporated into our account of ambiguity, although ours does not rely on structural differences between English and Chinese, as they do. More on this later in this chapter.

Ernst (1996) uses case assignment mechanism as another way to account for the limited scope ambiguity Aoun and Li ((1989) discusses.

(56) *wenge* *de shihou, zai Wuhan,*
Cultural Revolution DE time in Wuhan
'During (the time of) the Cultural Revolution, in Wuhan'

a. *meiyige xiaohai jiandao guo yiqi daren*
every-MW child see GUO one-MW beat-person
shijian.
incident
'Every child witnessed a beating incident.'

b. *meiyige xiaohai dou jiandao guo yiqi*
every-MW child dou see GUO one-MW
daren shijian.
Beat-person incident
'Every child witnessed a beating incident.'

(56a) has only one reading, the one where scope follows surface order. (56b), on the other hand, exhibits scope ambiguity; in addition to the reading of (56a), it also has the reading "There was a beating incident that every child witnessed". Under the latter reading, one can naturally add the qualifying sentence "That incident near the Red Flag Building, you must have heard of it," assuming that the speaker was talking about what it was like for the pupils in an elementary school near the Red Flag

Building in Wuhan during the early days of the Cultural Revolution. This second reading appears to be a case of scope readjustment.

Significantly, our skolemized definition of EVERY predicts that when both 'dou', which licenses the event variable, and an indefinite object noun phrase appear in the same sentence, scope ambiguity should occur. The skolem function will force a narrow scope interpretation with respect to EVERY on one variable, but the other variable, not being skolemized, should allow a wide scope interpretation under existential closure⁴. In a sentence without 'dou', the indefinite noun phrase provides the only variable for skolemization; and so it should take narrow scope with respect to EVERY. When the event variable is made available for skolemization by the presence of 'dou', however, the indefinite noun phrase should be available for existential closure higher up in the formula, thereby taking wide scope over EVERY.

The logical translations of (56a) and (56b) are given in (57). (57a) is the reading shared by (56a) and (56b) and (57b) is the additional reading of (56b).

(57) a. $\text{EVERY} (\{ x \mid \text{CHILD}(x) \}, \{ y \mid \text{AT}(\text{WITNESSED}(y, f(x))) \wedge$
 $\text{BEATING INCIDENT}(f(x)) \}$)

b. $(\exists z)(\text{EVERY} (\{ x \mid \text{CHILD}(x) \}, \{ y \mid \text{AT}(\text{WITNESSED}(y, z, f(x)))$

⁴ Recall that the existential quantifier introduced by the existential closure is assumed to be outside the formula in our system. This is different from Diesing's argument that E-closure applies at VP boundaries only. One consequence of our assumption is that there will be no unbound variables left in a formula, suggesting that indefinite NPs can serve as subjects in Chinese, which has some apparent counterexamples. This issue will be discussed in length in Chapter 4.

\wedge BEATING INCIDENT (z) \wedge DOU(f(x), WITNESSED))

(57a) means that for every child there was a beating incident such that the child witnessed the incident. (57b) means that there was a beating incident and for every child there was a minimal witnessing event such that the child witnessed the beating incident in that event. As we can see, the wide-scope reading in (57) results from existential closure of the variable introduced by the indefinite noun phrase.

Below are some natural sounding examples that support our claim of scope ambiguity with indefinites in Chinese. Both (58a) and (59a) have only one reading and the material in parentheses indicates the reading. In contrast, both (58b) and (59b) are ambiguous between the (a) reading and a wide scope reading of the indefinite noun phrase, in which case the material in parentheses is a natural continuation of the speaker's utterance.

(58) a. *zaijintiande wanhui shang, meiyige ren*
at today's DE evening-party on, every-MW person
dei bei yishou shi.
must recite one-MW poem.
(*Zhangsan bei yishou Li Bai de shi,*
Zhangsan recite one-MW Li Bai DE poem

Lisi bei yishou DuFu de shi, Wangwu bei
Lisi recite one-MW DuFu DE poem, Wangwu recite

yishou Wang Wei de shi.)

one-MW Wang Wei DE poem

'At the evening party tonight, everyone must recite a poem. (Zhangsan recites one by Li Bai, Lisi recites one by Du Fu, and Wangwu recites one by Wang Wei.)'

- b. *zai zheisuo you-er-yuan, meiyige xiaohai dou hui*
in this-MW kindergarten every-MW child dou can
bei yishou Tang shi. (jiushiLi Bai de "chuangqian
recite a-MW Tang poem. it-isLi Bai DE "bed-front
ming yue guang....")
brightmoon light...."

'In this kindergarten, every child can recite a Tang poem.
(It's Li Bai's "Bright moon light shining over my bed....")'

(59) *women jia ya, budeliao la*

we familyYA, my-Gosh

- a. *meiyige haizi mi yige gexing.*

every-MW child take-fancy a-MW singing star

(laoda mi Cui Jian, laoer mi Wei Wei,

old-bigtake-fancy Cui Jian, old-two take-fancy Wei Wei

laosan ne, mi Mao Amin)

old-threeNE, take-fancy Mao Amin

'Oh, my family! Let me tell you! Every child takes a fancy of a singing star. (For the oldest one, it is Cui Jian;

for the second one, it is Wei Wei; as for the third one, it is Mao Amin).'

- b. *meiyige haizi dou mi yige gexing.*
every-MW child dou take-fancy a-MW singing star
(*xin- bu- xin you ni, jiushi Cui Jian na!*)
believe-not-believe up-to you, it-is Cui Jian NA
'Oh, my family! Let me tell you! Every child takes a
fancy of a singing star. (Believe it or not, it's Cui Jian!).'

It is worth noting that in Chinese, the pairing between 'mei' noun phrase and an indefinite is so strong that very often the verb part in an utterance is totally left out so that just the subject and the object are left in the sentence, as shown in the following examples:

- (60) *jintianwanshang huican, zhayu guanbao,*
today night feast fried-fish guarantee-full,
liangjin zhong de yu, meiren yitiao
two-catty heavy DE fish, everybody one-piece
'At the feast tonight, fried-fish is abundant; the two-catty fish
everybody is guaranteed a piece.'

- (61) *mingtian de xuanju, meiren yipiao, buxu*

tomorrow DE election, everybody one-vote,not-allowed

nongxu-zuojia!

cheating

'At tomorrow's election, one person one vote; no cheating is allowed!'

As our account predicts, in (60) and (61), only the narrow scope reading of the indefinites is available. This is because each of them provides the only variable needed for the skolem function, thus they must stay inside the scope of 'mei'.

Now, let us consider the ambiguous passive sentence that Aoun and Li (1989:146) uses to support their scope principle.

(62) *meige ren dou beiyige nuren zhuazou le.*

every-MW person dou by one-MW woman arrest LE

'Every person was arrested by a woman.'

a. for every x, x a person, there is y, y a woman, such that x is arrested by y.

b. there is y, y a woman, for every x, x a person, x is arrested by y.

Aoun and Li explain the ambiguity in (62) in terms of their scope principle as given in (63)

(63) The Scope Principle

A quantifier A has scope over a quantifier B in case A c-commands a member of the chain containing B.

The schematic representation of the chain relation for (62) is given as follows:

(64) $QP_2 x_2 QP_1 x_1 t_2$ (passive)

QP_2 is the passive subject with a trace t_2 in the canonical object position; QP_1 is the Agent NP which is the indefinite NP in (62). In (64), QP_1 c-commands t_2 , while QP_2 c-commands QP_1 , hence the ambiguity⁵.

We can see that this passive sentence is a subclass of the data our account of ambiguity naturally subsumes. That is, the indefinite agent NP within the c-command scope of 'mei' provides an extra variable in addition to the event variable made available by 'dou'. The narrow scope reading of the indefinite obtains when it stays put for skolemization; if the skolem function takes the event variable, the indefinite NP is bound off by existential closure which applies at the top of the formula, thus positioning the indefinite NP in a position c-commanding the subject 'mei' noun phrase, hence the wide scope reading of the indefinite. Our account differs from Aoun and Li's not only in using different mechanisms, but also in predicting or permitting ambiguity in wider contexts, for instance, in active sentences, as we have done earlier, which Aoun and Li does not predict or permit.

⁵ For their full structural account of contrasts between English and Chinese in terms of ambiguity, see Aoun and Li (1989, 1993).

Unlike in English, in Chinese, when an indefinite precedes an 'every' ('mei') noun phrase in a sentence, there is no scope ambiguity. This fact reflects the constraint that scope order follows surface order in Chinese. C.- T. J. Huang (1982) argued, convincingly, that scope order should be defined in terms of c-command, not precedence, following Reinhart (1976)⁶. Suppose that we require universally that the variable skolemized by 'every' be associated with a phrase (for example, an indefinite NP) that 'every n' c-commands at some syntactic level. If the indefinite precedes the quantifier, no skolemization is possible and the variable introduced by the indefinite noun phrase will be quantified by existential closure higher up in the formula, with 'EVERY' inside its scope. In English, if the surface order yields wide scope for the indefinite over 'EVERY', scope readjustment may apply to produce the narrow scope reading. But Chinese, since it does not allow scope readjustment, will not allow the narrow scope interpretation of the indefinite.

2.2.5. *'Mei' in the Object Position*

⁶ A is in the scope of B if A c-commands B, where A c-commands B iff neither A nor B dominates the other and the first branching node dominating A also dominates B.

Let us now see what happens when a 'mei' noun phrase is the object of a verb. It has been observed in the literature that 'mei' noun phrases cannot appear in the post verbal object position (Cheng, 1991). We agree with Cheng's judgments. In general, 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. The contrast between the English sentence and the Chinese sentence given below will illustrate this placement constraint on a 'mei' noun phrase.

(65) John loves every woman.

(66) ??*Lisi xihuan meiyige laoshi.*⁷

Lisi love every-MW teacher

'Lisi likes every teacher.'

In fact, (66) is more like the awkward English sentence (67) where 'each' substitutes for 'every' (Kroch 1974):

(67) ??John likes each woman.

So once again we see that the 'mei' noun phrase behaves more like the

⁷ Cheng (1991:161) shows that the sentence is acceptable if the object NP has a contrast with "some teachers".

'each' noun phrase than the 'every' noun phrase. We will say more about this later.

Note that in (66), 'dou' cannot appear to rescue the sentence. This has to do with an empirical observation that in order to "relate" 'dou' with a 'mei' noun phrase, 'dou' has to be c-commanded by the 'mei' noun phrase. In (66), the 'mei' noun phrase is in the post-verbal position, thus not licensing 'dou'; in (68) below, where the object noun phrase with 'mei' is topicalized, 'dou' can be used:

- (68) *meiyige laoshi Lisi dou xihuan.*
every-MW teacher Lisi dou like
'Lisi likes every teacher.'

Another way to prepose the 'mei' noun phrase is to use the BA construction as shown below and the sentence is perfectly fine:

- (69) *Lisi ba meiyiben shu dou kan-wan le.*
Lisi BAevery-MW book dou read-finish LE
'Lisi finished reading every book.'

We can interpret the placement restriction on the 'mei' noun phrase in accordance with our skolemized definition of EVERY. In terms of that definition, 'mei' generally cannot appear in the post-verbal position because from there it will not find a variable in its c-command domain for skolemization.

2.2.6. *When is 'Dou' Optional?*

We now consider the advantage of this interpretation of the placement restriction in a larger context, namely, the optionality of 'dou' and relating the optionality to whether or not there is a variable within the appropriate c-command domain of 'mei'.

The placement restriction on 'mei' predicts that if there is a variable within the c-command domain of a post-verbal 'mei' noun phrase, the sentence should be acceptable, and this prediction is born out. Cheng (1991:165) points out that while 'dou' appears to be obligatory in the scope of 'mei'⁸, it is not in the following type of sentence:

- (70) *women jingli gei le meiyige daibiao yige liwu.*
we manager give LE every-MW delegate a-MW gift
'Our manager gave every delegate a gift.'

This fact is predicted by our skolemized definition of EVERY: The presence of 'dou' in the scope of 'mei' is required when a variable is needed for the skolem function to construct the second argument of EVERY, for 'dou' makes the event variable available for skolemization; if a variable is introduced by some other lexical phrase in the c-command domain of 'mei', then 'dou' does not have to be present. This is the case with all the sentences in which 'mei n' phrase is used in the subject position and an indefinite NP appears in the object position in Section

⁸ This, we already know, is not correct because we have seen that when there is an indefinite or an anaphoric expression in the scope of 'mei', 'dou' is not obligatory. This was noted in Huang (1995a).

2.1. In (70), the 'mei n' phrase and the indefinite NP 'yige liwu' are both in the post verbal position; the indefinite of course provides the variable for skolemization, thus, 'dou' is not needed in this sentence. As a matter of fact, 'dou' cannot be used to the right of 'mei' in (70) because being an adverb, 'dou' has to be in a preverbal position. (70) shows the absence of 'dou' is not missed if 'mei' finds a variable in its scope.

Also note that (70) is not ambiguous, because the first object NP 'meiyige daibiao' asymmetrically c-commands the indefinite NP 'yige liwu' (Larson 1988). Furthermore, the indefinite NP provides the only possible variable for skolemization and therefore no wide scope reading on this indefinite NP is feasible.

The reversed order between the 'mei' noun phrase and the indefinite in the double object construction results in a highly awkward sentence as shown in (71):

(71) **women jingli gei le yige daibiao meiyigeliwu.*
we manager give LE a-MW delegate every gift
'Our manager gave a delegate every gift.'

Once again this is predicted by the asymmetric c-command relation between the two object NPs. Since 'meiyige liwu' "every gift" is asymmetrically c-commanded by 'yige daibiao' "a delegate" and there is no variable that it c-commands, skolemization fails and the sentence sounds very unnatural.

A 'mei' noun phrase fares differently in a "serial verb construction" that is the equivalent of the dative construction in English. But as we will see, in the Chinese sentence, the direct object does not asymmetrically c-command the indirect object, as claimed for English (Larson 1988), instead the indirect object, the one case-marked by the verb-turned preposition 'gei' "give, to, for", asymmetrically c-commands the direct object.

(72) *women jingli song le yige liwu gei meiyige daibiao.*
 we manager give LE a-MW gift to every-MW delegate
 'Our manager gave a gift to every delegate.'

(73) **women jingli song le meiyige liwu gei yige daibiao.*
 we manager give LE every-MW gift to a-MW delegate
 'Our manager gave every gift to a delegate.'

As the contrast between (72) and (73) shows, if a 'mei' noun phrase is the indirect object introduced by the verb-turned preposition 'gei' in this construction, and an indefinite noun phrase is the direct object, the 'mei' noun phrase will have a variable in its scope and skolemization will be possible. This is the case in (72). If the roles are reversed, skolemization will fail and the sentence should be bad; and this is the case in (73). These facts suggest that the prepositional phrase in this construction is

higher up in the phrase structure than the direct object, so that the former c-commands the latter. This can be represented in English gloss as follows⁹:

(74) [VP [_v gave [NP one gift]] [PP to every delegate]]

We should note that it has been observed that prepositions like 'to' do not interfere with scope relations (May 1977).

Thus, the following sentences are ambiguous:

- (75) a. Everyone gave to some cause.
b. Some politician ran on every ticket.

In particular, 'to' does not interfere with the c-command relation, as evidenced by (76):

(76) I talked to every man about himself.

The preposition 'gei' behaves just like the preposition 'to' in English in that it does not interfere with the scope relation between the 'mei' noun phrase and the indefinite.

⁹ See Aoun & Li (1989:167) for a different account of sentences like (38), using a phrase structure different from Larson's, and with different scope readings. Particularly, they treat their equivalent of (38) as ambiguous, a reading that we do not accept.

The absence of 'dou' is observed in another type of sentence by Cheng (1991:165). The following is an example:

- (77) *woxihuan* [[*mei-ge* *xuesheng* *xie* *t*] *de* *wenzhang*]
I like every-MW student write DE article
'I like articles that every student writes.'

In this sentence, the 'mei' NP is the subject of the relative clause in the complex NP 'articles that every student writes'. The object is empty and is coindexed with the head noun 'wenzhang' "articles". Given our definition of EVERY, what 'mei' needs is a variable for skolemization. In (77), we can say that such a variable is available in the form of the empty object. Once the empty object is chosen for skolemization, we arrive at the paired reading between the subject and the object in the relative clause: For every student there is an article (or articles) such that the student writes the articles and I like the articles.

It should be further pointed out that not only is 'dou' not necessary in (77), it cannot be used in the relative clause as shown in (78) below:

- (78) **wo xihuan* [[*mei-ge* *xuesheng* *dou* *xie* *t*] *de* *wenzhang*]
I like every-MW student dou write DE article
Intended meaning: 'I like articles that every student writes.'

The ungrammaticality obviously has something to do with the fact the verb in the relative clause belongs to the creation type of verbs (Kroch

(1974), Diesing (1991)). The sentence forces a reading where articles that are liked have wide scope over 'mei', resulting in the anomalous meaning that the same articles underwent the creative writing processes by different people over and over again. But the full story is more complex than that. We will consider the relevant factors one by one and show that our skolemized definition of EVERY is indeed an adequate one even for seemingly very complex cases.

In his study of quantifier scopes in English, Kroch (1974:50-53) made an observation that when the verbs are of the creative type, such as 'write', 'paint', and 'draw', the indefinite object NP (i.e. 'a poem', 'a dog', 'a circle', respectively) cannot receive a wide scope reading with respect to 'each'. For instance,

- (79) a. John wrote a poem for each of his children.
b. Each of the children drew a circle.

Kroch notes that if a wide scope reading of the indefinite object NP is forced it results in anomalous interpretations because "(T)hey assert that a number of different people or entities are independently associated with a single object or entity by a relation which the object can only enter into once" (p.53). In other words if John writes a poem for his son Robert, that poem cannot be created again for his daughter Jane, as far as original poems are concerned. Kroch calls this type of verbs "creative verbs".

Diesing (1991) also considered verbs of creation and observed the

incompatibility between presuppositional (wide scope) readings of indefinite object NPs with respect to universal quantifiers when the verbs are of this type.

If we change the verb to the non-creation type, use of 'dou' in the relative clause is fine, as shown below:

(80) *woxihuan* [[*mei-ge* *xuesheng* *xuanzhongt*] *de* *wenzhang*]
I like every-MW student choose DE article
'I like articles that every student chose.'

(81) *wo xihuan* [[*mei-ge* *xuesheng* *dou xuanzhong t*] *de*
I like every-MW student dou choose DE
wenzhang]
article
'I like articles that every student chose.'

The verb 'xuanzhong', translatable as "successfully chose" but will be shortened to the past tense form "chose", is a non-creation type of verb. As we can see, 'dou' is optional with non-creation type of verbs in the relative clause. Interestingly, the interpretation of (80) differs from (81). (80) means that for every student there is an article (or articles) such that the students chose the articles and I like these articles. In other words each student is paired with an article or articles. This reading is predicted by our skolemized definition of EVERY because the skolem function forces the variable to be inside the scope of 'mei'. In

contrast, when 'dou' is present, as in (81), the event variable is made available. The reading for (80) is only vaguely available in (81) if we can get it at all. The preferred reading of (81) is that there is an article (or articles) and for every student, there is an event of article-choosing and the students chose the article or articles in that event and I like these articles. In this reading, each student is paired with an event.

The strong preference for the wide scope reading of the variable in (81) is reminiscent of the intended reading for (78). The difference between (79) and (81) is that the former involves a creation type of verb, thus the wide scope reading of the variable results in anomaly; the latter sentence involves a non-creation type of verb, therefore wide scope reading of the variable is fine.

It seems clear now that the wide scope reading of the variable in the type of relatives under discussion is the norm. We will attribute such preference to the fact that the head noun of such a complex noun phrase is in the c-commanding position of the 'mei' noun phrase; since the variable is coindexed with this head noun, wide scope reading of the variable is the most natural.

This explanation of the ungrammaticality of (78) and the preferred reading in (81) then puts the grammaticality of (77) into question: If the variable is inclined to have wide scope reading due to the c-commanding position of the coindexed head noun, why can it have narrow scope reading in (77)? Our answer again brings us back to the skolem function. EVERY is always associated with a skolem function. The skolem function needs a variable. If no unbound variable is available for skolemization,

the sentence is ill formed. In (77), even though the wide scope reading of the variable is preferred, there is no mechanism that prevents it from remaining in the narrow scope position for skolemization. Viewed this way, skolemization is a force of coercion in such sentences due to necessity, for well-formedness. As a matter of fact, because of the clash between the preferred wide scope reading of the object variable and the need for skolemization, (77) is not entirely natural¹⁰.

Some clarification is necessary here to prevent misunderstandings about the availability of a variable within the scope of 'mei'. It is important to note that only the variable present in the c-command domain of 'mei' from which the second argument of EVERY is constructed counts as useful for skolemization, because the sole purpose of having such a variable is to allow the skolem function to link it with the first argument of EVERY in such a way that the choice of a value for the second variable depends on the choice of a value for the first argument. Thus no variable in the definition of the first argument of EVERY is skolemizable even if it is in the c-command domain of 'mei'. For instance,

¹⁰ One might want to ask whether the variables introduced by wh-phrases are generally available for skolemization or not. The following sentence suggests that it is not clear.

- (i) ??*meiyizhi* *maozhua dao* *le shenme ?*
 every-MW cat catch-accomplish LE what
 'What did every cat catch?'

This sentence is odd. The absence of 'dou' forces the skolem function to find a variable other than the event variable. The fact that the sentence is not entirely out suggests that perhaps the skolem function may take the variable introduced by the wh-phrase. The not-so-perfect reading of (i) suggests that the question operator is a complicating factor. We will leave the issue open for further research.

(82) *meiyige qin le yige nuhai de nanhai *(dou) hui*
 every-MW kiss LE one-MW girl DE boy dou will
chuiniu.
 brag
 'Every boy who has kissed a girl will brag (about it).'

In (82), 'yige nuhai' "a girl" is an indefinite NP and is in the c-command domain of 'mei'. However, it is part of the relative clause that modifies the head noun whose denotation forms the first argument of 'mei', thus it is part of the first argument of EVERY. Its presence, therefore, does not facilitate skolemization which requires a variable for the second argument of EVERY. As expected, 'dou' is required in (82) to make the event variable available for skolemization; if not, the sentence is ruled out since no other variable is found in the relevant domain for that skolemization.

Another advantage of interpreting the placement restriction on the 'mei' noun phrase in accordance with our skolemized definition of EVERY, in conjunction with the c-command requirement on the scope order, is that we now have a natural way to account for the requirement that 'dou' be within the c-command domain of 'mei' noun phrase and in a preverbal position. This requirement on 'dou' has led to many different accounts proposed in the literature¹¹. Now we have found a way to

¹¹ For instance, Lee (1986), Chiu (1990, 1992), Cheng (1991), and Zhang (1996) all propose to account for the structural relation between 'mei-' and 'dou' from a syntactic point of view. S.-Z. Huang (1996) and Lin (1996) both discuss the structural relation between 'dou' and the "related" phrases from a semantic point of view.

"disassociate" 'dou' from the universal quantifier phrase.

According to our definition of EVERY, a 'mei' noun phrase is associated with a skolem function that binds a variable for pairing. Under C.-T. J. Huang's account, in which scope order is defined in terms of c-command and surface scope order is preserved in logical form (that is, no scope readjustment for quantifier and operator words), it is obligatory that the 'mei' noun phrase c-command the surface expression associated with the to-be skolemized variable. In the case where the event variable is to be skolemized, the 'mei' noun phrase has to c-command 'dou' because 'dou' is the surface element that licenses the appearance of the event variable in the (level 1) semantic translation of the sentence. It is also no accident that 'dou' is in the preverbal position: it is a sum operator that takes the event variable, which is located within the predicate VP, and as far as we can tell, all functors in English and Chinese appear to the left of their arguments.

Summing up, we have shown that Chinese indeed does not show much scope ambiguity, as C.-T. J. Huang and others have claimed. One place where scope ambiguity does obtain is where both an indefinite and the event variable (introduced by 'dou') are c-commanded by 'mei' and are for the construction of the second argument of EVERY. In this case, two variables are available for skolemization. Skolemizing one variable will result in the other being bound off by existential closure higher up in the formula in the logical translations. Thus, two different scope orders will obtain from a single sentence.

2.3. Conclusion

We conclude that the distribution of a 'every n' and 'mei n' phrases is predictable by our skolemized definition of EVERY: What is always required is that they have a variable in their c-command domain and this variable is part of the definition of their second argument, a requirement imposed by the skolem function. The placement restriction on an object 'mei' noun phrase in Chinese now follows from this general constraint: It can either appear in the preverbal position where it makes use of the event variable for skolemization if that is available; or it can appear in the post verbal position so long as there is an appropriate variable, most likely an indefinite phrase, within its c-command domain.

One issue we said we will discuss is whether our skolemized definition of EVERY can be a formal model for other universal quantifier determiners in both languages. We have said at the outset that the distribution of the determiner 'all' cannot be entirely captured by EVERY, because it can be used with collective predicates such as "leave together", in addition to distributive predicates. The same thing can be said about the quantifier determiner 'suoyoude' "all" in Chinese. However, it is not hard to see that 'each' and 'ge' "each" can also be modeled after EVERY. We have seen in this chapter that 'each' prefers overt indefinites in its scope in order for the sentence to be entirely natural. To some extent, 'mei' is more like the determiner 'each' than 'every'. Furthermore, Kroch (1974:59) notes that the pronoun 'everyone' and the NP 'every one' "have come to be used as pronominal forms for 'all' and cannot be taken simply

as pronominal forms of 'every'." Since our skolemized definition incorporates distributivity, 'everyone' and 'every one' cannot be always modeled after EVERY, just like 'all'.

Chapter 3

'Dou' and Partial Order

In Chapter 2, we proposed to interpret 'dou' as a sum operator that takes the event variable as its argument. This proposal was put forward to facilitate the application of our skolemized definition of EVERY to Chinese. In order to maintain the coherence of the discussion on the particular issues at hand in Chapter 2, we did not go into any detail to work out the sum operator treatment of 'dou', especially its validity and wider implications. This Chapter aims to provide a more systematic examination and exploration of this proposal.

3.1. 'Dou' and Sum of Events

The notion of an extra event argument associated with a predicate is already part of our analysis.

We will start with a model, M_E , very much like the one used in Lasersohn (1992). M_E as a structure $\langle E, \cup, P, \leq_E \rangle$ for interpreting events, E is a domain of events; \cup a sum function (defined as join in lattice¹); P a

¹ Meet, symbolized as \wedge , and join, symbolized as \vee , can be defined truth-conditionally (Lasersohn, 1992:382):

- (i) Where $x, y \subseteq \{0, 1\}$:
 - a. $x \wedge y = 1$ if $x = 1$ and $y = 1$; otherwise $x \wedge y = 0$
 - b. $x \vee y = 1$ if $x = 1$ or $y = 1$; otherwise $x \vee y = 0$

set of properties; and the events have a partial order, \leq_E defined on them², which can be understood as the part/whole relation. The partial order symbol reads 'less than or equal to'. Given two events, e_1 and e_2 , the sum (join) of the two events can be represented as $e_1 \cup e_2$, or $\cup\{e_1, e_2\}$.

The relation between events and properties can be defined as follows (ibid:392, with modifications). Note that the symbol \equiv stands for a relation between properties and events such that $e_i \equiv p$ reads 'p is true at e_i '.

- (1) For all $e, e' \in E; p \in P$,
 - a. if $e \equiv p$ and $e \leq_E e'$, then $e' \equiv p$.
 - b. if $e \equiv p$ and $e \equiv q$, then $e \equiv p \wedge q$

For concreteness, let us take an example. Suppose that *Mary is smart* is true in e_1 , and that *Mary is hard working* is true in e_2 , e' is the sum of e_1 and e_2 , namely $e_1 \cup e_2 = e'$, then by (a) *Mary being smart* is true in e' , because $e_1 \leq_E e'$; by the same token, *Mary being hard-working* is true in e' , because $e_2 \leq_E e'$. Furthermore, *Mary being both smart and hard working* is true in e' by (1b).

² The following is the definition of partial order from Landman (1991:83-85)

- (i) R is a partial order \leq iff R is reflexive, transitive and antisymmetric.
- (ii)
 - a. R is reflexive iff $\forall a \in A: R(a, a)$
 - b. R is transitive iff $\forall a, b, c \in A: R(a, b) \wedge R(b, c) \rightarrow R(a, c)$
 - c. R is antisymmetric iff $\forall a, b \in A: R(a, b) \wedge R(b, a) \rightarrow a = b$

The partial order symbol \leq reads as "less than or equal to".

For the above example, we propose to interpret 'both...and...' as a two-place sum operator on the event variables. Note that in this example, the two events are not of the same kind, i.e., one is the being smart kind and the other is the being hard-working kind. However, sum operations on same-kind events are possible too. This is how we will interpret the event of Mary and John both being smart, because this is true if and only if Mary is smart and John is smart. The event in which Mary and John are both smart thus should be interpreted as a plural event made up by two singular events. In this case, 'both' can be interpreted as a sum operator of two singular events of the same kind. Similarly, VP-*all* as in 'Mary, John, and Bob are all smart' is also a sum operator on events of the same kind, differing from 'both' in that the number of events resulting from the sum operation under 'all' is equal or higher than three.

Next, let us apply this line of thinking to Chinese. We note here that in Chinese, conjunction between two nouns or noun phrases is done by *he* or *gen* "and" (only *he* will be used in our discussion thereafter), but conjunction between two verbs or verb phrases is done by *ye*, hence the difference as illustrated in (2) below:

(2) a. *Zhangsan he Lisi*
 'Zhangsan and Lisi'

b. *Zhangsan chang le ge *he tiao le wu.*
 Zhangsan sing LE song *he danceLE dance

- c. *Zhangsan chang le ge ye tiao le wu.*
 Zhangsan sing LE song ye danceLE dance
 'Zhangsan sang and danced.'

Thus we will model 'ye' as the sum operator for the event variables.

The difference between 'ye' and 'dou' is similar to that between verbal 'and' and 'all' in English in that 'ye' denotes a sum operation on finite events as in (3) and (4); while 'dou' takes as its argument the event variable, which means it operates on an arbitrary number of events³:

- (3) a. *Zhangsan zou le. Lisi ye zou le.*
 Zhangsan leave LE. Lisi also leave LE
 'Zhangsan left. Lisi also left.'

- b. *Zhangsan he Lisi dou zou le.*
 Zhangsan and Lisi dou leave LE
 'Zhangsan and Lisi both left.'

- (4) *meiyige laoshi dou zou le.*
 every-MW teacher dou leave LE
 'Every teacher left.'

³ We are using sentences (3) merely to draw out some parallel between 'ye' and 'dou'. We do not intend to say anything about conjunction reduction here.

Assuming e is the event variable of a predicate PRED, and under the sum operator account of 'dou', 'dou PRED' is translated in the logical representation as (5):

$$(5) \quad \{x \mid \text{DOU PRED}(x)\} = \{x \mid \text{AT}(\text{PRED}(x,e)) \wedge \text{DOU}(e, \text{PRED})\},$$

and 'DOU(e , PRED)' is defined as in (6):

$$(6) \quad \text{DOU}(e, \text{PRED}) = \cup\{e_{\text{PRED}1}, e_{\text{PRED}2}, \dots, e_{\text{PRED}n}\}, \text{ and } \text{DOU}(e, \text{PRED})$$

is true iff e is an event of minimum size consistent with the semantics of PRED.

By the definition in (6), it is required that 'dou PRED' be associated with a plural event argument which is a sum of minimum events; this entails that the set of individuals denoted by 'dou PRED' has more than one member.

Given (5) and (6), the denotation of 'x dou cry' is the set of singular individuals each of which cries at the minimum event and these minimum events are lumped together into a sum of such events and thus more than one singular individual is in the denotation of 'x dou cry'.

Likewise, the denotation of 'x dou meet' is a set of "plural individuals" (Link 1983; Landman 1991) who constitute the minimum arguments of the predicate 'meet', in this case pairs of individuals, and the sum of such events entail that there is more than one such pair of individuals in the denotation set. Thus, 'a, b, c dou MEET' is fine but 'a

and b *dou* MEET' is not. In the former case, three minimum pairs can be formed, i.e., <a, b>, <b, c>, and <c, d>. However, in the latter case, there is only one pair <a, b>, which is involved in only one meeting event, hence it is a mismatch for *dou* MEET, which is a sum of at least two minimum events.

When the predicate is collective (group-level), such as 'surround', there is no incompatibility between 'dou' and the predicate. All '*dou* (collective)PRED' requires is that the minimum arguments of this predicate are of the right size. Assuming that 'regiment' is defined to refer to plural individuals, one can say 'The REGIMENTS *DOU* SURROUNDED A TOWN' in Chinese.

One piece of evidence that clearly proves that '*dou* PRED' requires that the event argument associated with it has to denote a sum of minimum events can be derived from the so-called once-only predicates as discussed in Szabolcsi and Zwarts (1993). The following are their original examples (91), (92), and (93), respectively:

- (7) a. Who showed this letter_{token} to Mary?
John and Bill did / John did and Bill did.
Bill did / Only Bill did.
- b. Who got a letter from Mary?
John and Bill did / John did and Bill did.
Bill did / Only Bill did.

- (8) a. Who got this letter_{token} from Mary?
 John and Bill did / *John did and Bill did.
 Bill did / (*)Only Bill did.
- b. Who burned this letter?
 John and Bill did / *John did and Bill did.
 Bill did / (*)Only Bill did.
- c. Who won the Rimet Cup in 1978?
 Argentina did / *Only Argentina did.
- (9) Who got his favorite letter from Mary?
 John and Bill did / John did and Bill did.
 Bill did / Only Bill did.

Only 'burned the letter_{token}' and 'got this letter_{token} from Mary' are once-only predicates, in contrast to predicates in (7) and (9). As Szabolcsi & Zwarts (1993) note, predicates like 'burned the letter_{token}' and 'got this letter_{token} from Mary' are associated with a singular event argument since these events can only take place once, hence the name "once-only predicate". The denotation of the event argument cannot be a sum of minimum events, thus the predicate cannot denote a set with more than one singular individual, although they can denote plural individuals (as engaged in group acts). This property of once-only predicates then predicts that they cannot be modified by 'dou' or any other adverbial sum operators. This prediction is indeed born out, as we can see in the following sentence:

- (10) a. *Zhangsan shao le zheifeng xin, *Lisiye/you shao le*
 Zhangsan burn LE this-MW letter, Lisi also/again burn LE
zheifeng xin.
 this-MW letter
 'Zhangsan burned this letter, *and Lisi also burned this
 letter.'
- b. *Zhangsan he Lisi (*dou) shao le zheifeng xin.*
 Zhangsan and Lisi (dou) burn LE this-MW letter
 *'Zhangsan and Lisi both burned this letter.'

3.2. 'Dou' and Partial Order

By treating 'dou' as a sum operator, we would like to speculate that this status of 'dou' allows 'dou PRED' to induce or to be associated with a partial order for the interpretation of the sentence that contains such a predicate.

Recall that our skolemized definition of EVERY follows the standard generalized quantifier theory in treating the first argument of EVERY as holding a subset relation with the denotation of the second argument of EVERY, namely the predicate denotation, differing from the standard generalized quantifier theory only in that the second argument is skolemized.

Note that the subset/superset relation between the NP denotation and the predicate VP denotation can be viewed as a partial order⁴ represented as \leq , defined under meet (intersection in set theoretic terms). The element to the left of the symbol is said to have a less than or equal to relation with the element to the right. Thus, $a \leq b$ iff $a \wedge b = a$ (Keenan and Faltz, 1985). So in 'Every dog barks', the set of dogs is less than or equal to the set of individuals that BARKS denotes because intersection of the two sets would yield the set of dogs.

We propose that a 'dou PRED' actually can be interpreted as always standing on the right hand side of the partial order with respect to its argument.

This analysis of 'dou PRED' might extend to English as well. Dowty (1986) has described VP-'all' as having a "maximizing effect" on the plural subject NPs. For instance, the difference between (11) and (12)

(11) The children sang.

(12) The children all sang.

is that while (11) can be interpreted as true even if there are exceptions to this statement, (12) allows no exceptions in order to be interpreted as true.

⁴ Although the opposite is not necessarily true, that is, not every partial order involves universal quantification, as we will see soon.

The same effect is observed with 'dou PRED' as the following sentences would show⁵:

- (13) a. *Zhangsan, Lisi, Wangwu dou chang le ge.*
Zhangsan, Lisi, Wangwu dou sing LE song
'Zhangsan, Lisi, and Wangwu all sang.'
- b. *tamen dou chang le ge.*
they dou sing LE song
'They all sang.'
- c. *haizi men dou chang le ge.*
child PL. dou sing LE song
'The children all sang.'

Now we have a quite simple way to account for the maximizing effect observed in VP-'all' and 'dou PRED' sentences with plural subjects. As we have seen, in the partial order the left hand element is less than or equal to the right hand set. This is a set relation and thus no exceptions are allowed. If 'dou PRED' is viewed as inducing a partial order in (13) with the predicate denotation standing in the higher or equal value position, then the subject denotation set, in the lower or equal value position, is bound to include every member of the set. Interestingly, our account of 'dou' handles both the maximizing and minimizing effects associated

⁵ Hou (1976) described 'dou' as having a totality effect.

with 'dou', maximizing in the sense of not allowing exception in the denotation of the argument 'dou PRED' is predicated on, and minimizing in the sense of the size of the events--'dou' requires that only minimum events be joined into the sum of events.

We believe that what is responsible for the partial order relation between the subject denotation and predicate denotation is the fact that 'dou' is an arbitrary sum operator⁶. 'Dou PRED' is always associated with $\cup\{e_{PRED1}, e_{PRED2}, \dots, e_{PREDn}\}$, which is $\cup E_{PRED}$, the lowest upper bound of events⁷. An informal way to explain the effect of $\cup E_{PRED}$ is that because of this sum of arbitrary number of events, 'dou PRED' asserts that the denotation of PRED has to be higher than or equal to the denotation of its argument.

We will put all this into a hypothesis:

(14) **Hypothesis on 'Dou PRED'** (HDP)

'Dou PRED', with its event argument defined as $\cup E_{PRED}$, induces or is associated with a partial order \leq in which the PRED denotation stands in the more than or equal to relation with its subject argument in the partial order. In other words, the predicate denotation appears on the right hand side while the subject

⁶ The two terms 'finite' and 'arbitrary' are borrowed from Keenan and Faltz (1985), in which they employ Boolean algebra to describe natural language phenomena.

⁷ Let $\langle A, \leq \rangle$ be a partial order and let A' be a subset of A .
 A' has an upper bound in A iff $\exists a \in A \forall a' \in A': a' \leq a$
 A' has a lowest upper bound in A iff $\exists a \in A$ [a is an upper bound for A'
and $\forall a' \in A$ [if a' is an upper bound for A' then $a \leq a'$]]
(Landman, 1991)

denotation appears on the left hand side of the partial order.

In the following sections, we will test the HDP in a number of diverse contexts.

3.2.1. *'Dou' and Plural NP Arguments*

HDP provides a principled way to account for the sentences in (13). (15) is the partial order representation of (13c):

(15) { (contextually defined) children} \leq {individuals who sang}

The partial order relation puts the entire set denoted by 'haizi men' into a less than or equal to relation with the predicate denotation set, in contrast to a similar sentence without 'dou':

(16) *haizi men chang le ge.*
child PL. sing LE song
'The children sang.'

Without 'dou', there is no required sum operation on the event argument, there is then no $\cup E_{PRED}$, the arbitrary sum of events, and consequently there is no partial order induced with the PRED denotation on the right

hand side in the partial order with the subject denotation standing in a less than or equal to relation with the predicate denotation, hence, the sentence will be interpreted as true even if not all members of the subject participated in the events. The point we want to drive home is that, 'dou' is not directly universally quantifying over the plural subject NP even though universal quantificational reading is obtained in such sentences; rather it is the partial order it helps to induce that puts the plural subject denotation set in the lower value position which entails that each member of the set has the property the predicate stands for.

NPs modified by 'dabufen' "most" and 'henduo' "many" can also be predicated on by 'dou PRED'. We will simply take 'dabufen' and 'henduo' as predicates that restrict the denotation of the N they modify to the appropriate proportions and 'dou PRED' will put them in the left hand position while the denotation of the 'dou PRED' will stand in the right hand position in the partial order. The following are examples involving 'dabufen' and 'henduo':

(17) a. *dabufen de ren dou zou le.*
 most DE person dou leave LE
 'Most people left.'

b. *henduo ren dou zou le.*
 many person dou leave LE
 'Many people left.'

Under HDP, we would expect to find unacceptable those sentences in which the predicate 'dou' is associated with denotes a set that stands in a less than or equal to relation to its subject argument. This prediction can find empirical support from a certain type of sentence. The relevant sentence involves 'only' on the subject NP.

'only' induces a partial order that is the dual (opposite) of the partial order that 'meiyige' or 'dou' can induce⁸.

(18) a. *meiyige* A B = $A \leq B$

b. A *dou* B = $A \leq B$

(19) only A B = $A \geq B$

Let us use natural language sentences to illustrate these relations. We know that 'Every student left' has a relation where if one is a student, one has the 'left' property; but it is not necessarily true that all those who left are students, or more succinctly, in this sentence the denotation of STUDENT is a subset of the denotation of LEFT, but the denotation of LEFT is not a subset of STUDENT.

'Only students left' has exactly the opposite relation. It means that all those who left have the student property, but it is not necessarily true that all students left. In other words, the denotation of STUDENT is a superset of the denotation of LEFT (Horn (1969), McCawley (1974)). Again converting this subset/superset relation to a partial order, in (19),

⁸ We leave out the skolem function in (19) and in subsequent examples in this chapter when nothing hinges on it.

the subject denotation has a more than or equal to value in the partial order while the predicate denotation has a less than or equal to value. Therefore we do not expect to find 'only' to be compatible with 'dou PRED' and this is true:

- (20) **zhiyou xiaohai dou chang le ge.*
 only child dou sing LE song

Summing up, the subject NPs examined in this section are all compatible with 'dou PRED' in terms of their ability to enter into a partial order required by HDP⁹.

⁹ One issue that need be resolved is the sentence in (i):

- (i) *zuotian, yige laotou he yige lao taitai (*dou)*
 yesterday, one-MW old man and one-ME old woman
bing le.
 sick LE
 'Yesterday an old man and an old woman (*both) got sick.'

The subject NP in (i) is a conjunction and yet 'dou' cannot co-occur with it. This is in contrast with earlier examples where the subject is a conjunction of definite NPs, such as 'Zhangsan and Lisi'. Obviously, what 'dou PRED' needs is not just any conjunction, but a conjunction of definite NPs. The indefinite NPs in this sentence obviously have an existential interpretation and existential quantification can be likened to 'some', which is (almost) reflexive and symmetric (Benthem (1988:91)). Recall that a partial order is defined, in footnote 2, as reflexive, transitive, and antisymmetric; therefore conjunction of indefinite NPs are barred from serving as the subject for 'dou PRED', because of the HDP. In contrast, the following NPs that we have examined are all compatible with a partial order reading between the subject denotation and the predicate denotation: 'mei- n', 'dabufen n' "most n", 'henduo n' "many n", 'Zhangsan he Lisi' "Zhangsan and Lisi", and 'Zhangsan'. We will see in the next chapter that plural numeral NPs such as 'sange ren' "three persons" can also be the subject of 'dou PRED'.

3.2.2. 'Dou' and Sentence Final 'le'

However, our hypothesis on 'dou' is still susceptible to a serious challenge. For instance, one might wonder whether this account should be preferred to the currently dominant accounts that take 'dou' as a universal quantifier on the subject. We will show below that there is indeed substantive difference: Even though the subset/superset relation 'every' induces can be converted into a partial order, not every partial order has to involve universal quantification. If we can show that 'dou' is "marking" the right hand element in a partial order \leq which does not involve universal quantification, then our proposed account of 'dou' will have an advantage over the universal quantifier account of 'dou'. This section is a test of our HDP with this particular issue in mind.

In S.-Z. Huang (1995a), we argued for the position that 'dou' should not be treated as a universal quantifier for a number of reasons, one of them being its occurrence in the following type of sentence.

- (21) *Zhangsan xue Zhongwen dou xue le san nian le.*¹⁰
Zhangsan study Chinese dou study LE three year LE
'Zhangsan has studied Chinese for three years.'

¹⁰ This sentence involves verb copying. Verb copying is a common phenomenon in Chinese. For a full discussion of this issue, see C.-T. J. Huang (1982) and Y.-H. A. Li (1990), among many others.

To the analyses that treat 'dou' as a universal quantifier, this sentence may appear intriguing in that *dou* finds (21) a felicitous environment to appear, even though the subject is a singular NP and there is no universal quantification reading.

We argued that instead of being a universal quantifier on the subject, 'dou' requires that the predicate be associated with a cluster of events. Under the current account of 'dou', 'dou' is the sum operator that takes minimum events as its arguments. The minimum events in (21) are Zhangsan studying Chinese in the past and Zhangsan studying at the moment, as the English translation accurately indicates. The fact that the subject denotes a singular individual is not an issue in our account since 'dou' is a sum operator on events and in this sentence there are more than one event.

Note that in S.-Z. Huang (1995a), we took (21) to have a presupposition that Zhangsan studied Chinese for three years and an assertion that Zhangsan is still studying Chinese now. We used the standard negation test to support this claim. We believe now that this is not quite right. We will show our negation test first and then point out what went wrong.

The rationale behind the negation test is that a component of the meaning of a sentence is presupposition if it holds true even when the sentence is negated (Austin (1958)). Suppose that after A uttered (21), B said:

(22) *bu, suiran Zhangsan xue Zhongwen xue le*
 No, although Zhangsan study Chinese study LE
san nian, ta xianzai mei xue le.
 three year, he now not study LE
 'No, although Zhangsan studied Chinese for three years, he's not
 studying it any more.'

We claimed that what is being negated by B is the assertion part of the meaning of (21), namely Zhangsan is still studying Chinese, not the presupposition part of (21), namely he studied Chinese for three years.

(22), upon closer examination, turns out to be not quite the test it is supposed to be. (22) separates (21) into two clauses and while using 'xue Zhongwen' "study Chinese" in the 'although' clause, it puts 'xue le sannian le' "has studied for three years" into the clause with negation. A true negation test ought to be one that has everything of the original sentence intact plus the negation morpheme. (22) is not such a sentence but (23) is.

(23) *Zhangsan xue Zhongwen hai mei xue san nian.*
 Zhangsan study Chinese still not study three year
 'Zhangsan has not studied Chinese for three years yet.'

In (23), both the proposition that Zhangsan studied Chinese for three years and that he is studying Chinese now are negated, showing that in fact both propositions are assertions¹¹.

That (21) asserts more than one proposition is attributable to the presence of the sentence final 'le', an aspect morpheme that has been given a number of names, most common of which is "new situation -le". Li and Thompson (1981) described the sentence final 'le' as signaling "Currently Relevant State", but this coinage is too restrictive, as we will see later in this section. Given (21), to call the sentence final 'le' a morpheme that indicates "new stage" might be more accurate. For convenience, since nothing hinges on it, we will call this 'le' SF (sentence final) 'le'. While the predicate minus the SF 'le' asserts that Zhangsan studied Chinese for three years, the SF 'le' makes the assertion that Zhangsan is still studying Chinese now.

The former proposition could be said to be true at e_1 and the latter could be said to be true at e_2 . This way the predicate is associated with two events and 'dou' appears to perform a sum operation on them, resulting in $e_1 \cup e_2$, as formally represented in (24):

(24) AT(STUDIED CHINESE FOR THREE YEARS \wedge STUDY CHINESE
NOW (Zhangsan, $e_1 \cup e_2$))

¹¹ Note that the post-verbal 'le' cannot appear in the negated form of the sentence because, the negation morpheme 'mei' can be interpreted as subsuming NEG and 'le' (Wang (1965), C.-T. J. Huang (1982)). We will take the absence of the sentence final 'le' as a result of the loss of the first 'le', since the first 'le' creates the necessary condition for the use of the sentence final 'le'. More on the sentence final 'le' in the next paragraph.

The assertion of the proposition that Zhangsan is studying Chinese now is crucial for invoking e_2 , which in turn is crucial for the use of 'dou', for 'dou' requires that the predicate be associated with more than one event. This account of the function of the SF 'le' predicts that absence of this *le* in (21) should result in the exclusion of 'dou', which, as we can see below, is true.

- (25) *Zhangsan xue Zhongwen (*dou) xue le san nian.*
 Zhangsan study Chinese (*dou)study LE three year
 'Zhangsan studied Chinese for three years.'

All this sentence means is that there is an event in which Zhangsan studied Chinese for three years, but there is no mention of any continuation, hence no e_2 . Consequently 'dou' cannot be used in (25).

This line of thinking, however, as it is presented above, is not adequate to explain sentences like (26), also discussed in S.-Z. Huang (1995a). To be sure, both sentences in (26) have, uncontroversially, the sentence final SF 'le', without which all the sentences are unacceptable.

- (26) a. *zheiduo huar dou hong le.*
 this-MW flower DOU red LE
 'This flower is red already.'
- b. *wo nuer dou yijing cong daxue biye le.*
 mydaughter dou already from college graduate LE

'My daughter has already graduated from college.'

There is, however, a difference between (21) and (26) that merits some further discussion. Let us take (26a) as an example. Adopting our double-assertion account, we will have (27).

- (27) a. Assertion 1: This flower was not red before at e_1 .
b. Assertion 2: This flower is red now at e_2 .

In (27), the predicate minus the SF 'le', namely 'hong' "red", is NOT true at e_1 . The problem this poses to our account can be eliminated if we make some modifications. We argue that SF 'le' actually induces a partial order on periods or points of time¹² defined as a linear order with an 'earlier than' relation. What 'dou' does here, as it does in (21), is to be a sum operator on the two event arguments at two different intervals of time with e_1 earlier than e_2 .

Suppose T is a set of periods or points of time and $<$ a partial order on T :

- (28) a. NOT RED (this flower) is true at e_1 , and RED(this flower) is true at e_2
b. $t_i, t_{\text{now}} \in T$, and $t_i < t_{\text{now}}$, e_1 is associated with t_i and e_2 is associated with t_{now} .

¹² There is no indication that perfective (complete action) 'le' can do the same, as (25) shows.

According to (28), (26a) should be interpreted as saying that two intervals of time have an earlier than relation between them and this flower has gone from an earlier time at which it is in a state of not-red to a later time interval that is t_{now} at which it is in a red-state.

With the two assertions, the event argument of the predicate refers to two events. In this case, 'zheiduo huar' "this flower" denotes a set, which is a singleton set, that is a subset of the denotation of 'hong le' "red", and this subset/superset relation can be converted into a partial order between the denotation of the subject NP and that of the predicate, with the former being in a less than or equal to relation to the latter, or put it differently, the predicate denotation is in a more than or equal to relation with the subject denotation, thus proving the HDP.

'Dou' apparently does not induce an arbitrary sum operation in (26), for arbitrary sum operator has to take events of the same kind as its argument. This may very well be true, since not being red and being red are not the same kind of events; as a matter of fact, they are opposite kinds of events. However, this does not seem to matter in (26): The presence of the SF 'le' induces the partial order on time. What remains constant in sentences in (26), as far as 'dou' is concerned, is the fact that there is more than one event and therefore sum operation on events can be performed; in addition the denotation of 'dou PRED' stands in the right hand side of the partial order \leq , because the subject denotation is less than or equal to it.

Given the modifications in our account of sentences with 'dou' and

SF 'le' such as in (26), let us bring the analysis of (21) in line with the current proposal.

Assume, as we have done with sentences in (26), the SF 'le' in (21) induces a partial order on time with t_{now} as having a higher value in that linear order.

Suppose T is a set of one-year periods of time and $<$ a partial order on T defined as 'earlier than':

- (29) a. STUDY CHINESE FOR THREE YEARS(z) is true at e_1 ,
STUDY CHINESE NOW (z) is true at e_2 ,
- b. $t_1, t_{\text{now}} \in T$, and $t_1 < t_{\text{now}}$, e_1 is associated with t_1 , and e_2 with t_{now} .

SF 'le', not only induces the linear order on time, but pinpoints the speech time NOW (Kamp, 1971) to be the right hand element in the linear order, thus forcing the existence of an earlier point or period of time. In (21) and (26), because the asserted event by SF 'le' is associated with t_{now} , and t_{now} occurs on the right hand side of the linear order, the event argument of the predicate has to refer to an event that is associated with the earlier point or period of time. Thus, the use of SF 'le' always induces a change of state on events.

It is worth pointing out that 'dou' in (21) and (26) is generally interpreted and translated as "already". This does not seem right, since

in (26b) 'yijing' "already" co-occurs with *dou*; as a matter of fact, one can add 'yijing' to all sentences in (21) and (26) with 'dou' present. What seems to be happening is that there is an interdependent relation among 'yijing', 'dou' and the SF 'le': 'le' signals change of state from previous state(s) to current state; and any change to a new state signals the ending of the previous state, thus creating the right context for 'yijing'. On the other hand, SF 'le' induces a linear order on time on which a cluster of events is associated, and the use of 'dou' is appropriate. In this scheme of things, 'dou' itself does not mean "already".

This analysis is further supported by the fact that, while 'yijing' would find the perfective 'le' a perfect co-occurring companion, 'dou' does not. One may take this to mean that a perfective 'le' only indicates completion of action, but does not induce a linear order on time with which two or more events can be associated at different time points or intervals.

- (30) *Zhangsan xue Zhongwen (*dou) yijing xue le*
 Zhangsan study Chinese dou already study LE
*san nian*¹³.
 three year
 'Zhangsan studied Chinese for three years.'

¹³ The relative order between 'dou' and 'yijing' within a sentence can be altered in some contexts, but not so in this sentence:

- (i) *Zhangsan xue Zhongwen yijing (*dou) xue le san nian.*
 Zhangsan study Chinese already dou study LE three year
 'Zhangsan already studied Chinese for three years.'

We therefore conclude that 'dou' does not mean 'already' (for an opposing view, see Tsai (1994:23-24)), nor is it a universal quantifier, since in (21) and (26) the subjects denote singleton sets and there is no universal quantification reading in the sentences. 'Dou' is used felicitously in these sentences because there 'dou PRED' is associated with a plural event (sum of two asserted events), due to the presence of the SF 'le', which always asserts that a certain event is true at t_{now} , in addition to another event true at a point or period of time earlier than t_{now} . This analysis of 'dou PRED' and SF 'le' predicts that any predicate with SF 'le' is associated with two asserted events and thus it is a felicitous environment for the use of 'dou', if the subject NP is of the right type, as discussed in footnote 8 in the previous section.

3.3. 'Dou', 'Ye' "also, and", and 'You' "again, also"

In Section 3.1., we compared 'dou' with the adverb 'ye' "also, and". In this section, we will test our HDP against a set of data involving the interchangeability among 'dou', 'ye', and a third adverb 'you' "again, also" in a number of contexts.

One interesting aspect of 'ye' is that it can be used in the first sentence in (31) because of the second sentence, which contains an identical predicate:

(31) *Zhangsan ye zou le, Lisi ye zou le.*

Zhangsan also leave LE, Lisi also leave LE

'Both Zhangsan left and Lisi left.'

The first 'ye' is used in anticipation of a sum operation on two separate events denoted by two separate sentences. Without the second sentence, the first sentence cannot use 'ye', unless, of course, it takes as presupposition a previous sentence with identical predicate. This "doubling" of 'ye' can happen within the same sentence if the same subject is involved in two separate events as shown in (32):

(32) *Zhangsan ye da lanqiu ye da paiqiu.*

Zhangsan also play basketball also play volleyball.

'Zhangsan plays both basketball and volleyball.'

'You' is another word that can also be interpreted as a sum operator on events. The basic meaning of 'you' can be captured in the following sentence where it means "again":

(33) *ta you lai le.*

he again come LE

'He came again.'

'Ye' and 'you' can be used interchangeably with verbal predicates:

- (34) a. *ta ye/you hui shuo Zhongwen ye/you hui shuo Dewen.*
 he ye/you can speak Chinese ye/you can speak German
 'He can speak both Chinese and German.'
- b. *Zhangsan ye/you xiang qu Wuhan ye/you xiang*
Zhangsan ye/you want go Wuhan ye/you want
qu Tianjin.
 go Tianjin
 'Zhangsan wants to go to both Wuhan and Tianjin.'

One difference between 'ye' and 'you' is that 'you' can conjoin two adjectival predicates while 'ye' cannot:

- (35) *ta *ye/you congming *ye/you yonggong.*
 he *ye/you smart *ye/you hard-working
 'He is both smart and hard-working.'

The difference between 'ye' and 'you' in this context can be simply attributed to some lexical semantic preferences for predicates. The difference notwithstanding, we get the gist of what 'ye' and 'you' can do--they are both sum operators that can mark each of their conjuncts¹⁴.

In conjoining two verbs (or VPs), 'both...and...' is similar to 'ye...ye...' and 'you...you...', except that 'both...and...' is restricted to taking two arguments, while 'ye/you' have no such restriction. In this

¹⁴ There are other ways of using these lexical items, but they will not be relevant to our concerns here.

regard, 'ye/you' are more like adverbial disjunction operator 'either... or...' where 'or' can be repeated to take as many arguments as can be.

(36) You can either go to LA, or Boston, or New York, or Philadelphia; the choice is yours.

(37) a. *ta ye/you xihuan Jingju, ye/you xihuan*
he ye/you like Peking Opera, ye/you like
Yueju, ye/you xihuan Yuju.
Shanghai opera, ye/you like Henan Opera
'He likes Peking Opera, Shanghai Opera, and Henan
Opera.'

b. *ni didi ye lai, meimei ye lai, meifu*
you brother ye come, sister ye come, brother-in-law
ye lai, zhizi ye lai, wo shang nar qu zhao
ye come, nephew ye come. I go where go look
nemduo beizi ya.
so many quiltYA
'Your brother is coming, your sister is coming,
your brother-in-law is coming, and your nephew is also
coming. Where can I find so many quilts?'

(38) *ta you bu neng jintianlai, you bu neng mingtian lai,*
he you not can today come, you not can tomorrow come

you bu neng houtian lai. ni shuo ba,ta
 you not can day-after-tomorrow come you say BA, he
shenmeshihou neng lai?
 what time can come
 'He can neither come today, nor tomorrow, nor the day after
 tomorrow. Tell me, when can he come?'¹⁵

(The sentence final BA and YA are what have been called "mood" particles in traditional grammar.)

Given the above data, one might speculate that it may have been an accidental gap in English that the adverbial 'both...and...' is only a two-place operator.

One similarity between 'dou' and 'ye'/'you' is that 'dou' cannot be used as sum operator on nouns (or NPs) either:

(39) **douxuesheng lai le.*

dou student lai LE

Intended meaning 'All students came'.

As in contrast with (40)

¹⁵ Again the marking of each conjunct by 'neither...nor...nor...nor' is a perfect parallel of Chinese and this time the cardinality is not restricted to two on 'either', it is arbitrary.

- (40) *(neixie) xuesheng dou lai le.*
 (those) student dou come LE
 '(Those) students all came.'

The strongest pieces of evidence supporting the notion that 'dou' can be compared to the adverbial sum operators 'ye' and 'you' on the event argument come from sentences where they can be used interchangeably, in those cases 'dou', 'ye', and 'you' in fact all function as sum operators that take the event variable as their argument.

3.3.1. *Lian A Dou/Ye B* "even A B"

This section aims to examine a case of shared distribution between 'ye' and 'dou'. This occurs in the scope of 'lian' "even", as given in (41) below¹⁶:

- (41) *lian Zhangsan dou/ye juan le yi qian kuai qian.*
 even Zhangsan dou/ye donate LE one thousand dollar money
 'Even Zhangsan donated one thousand dollars.'

¹⁶ The 'lian... dou/ye' construction is described in some detail in Li and Thompson (1981:335-339). Shyu (1994) is the latest study, as far as we know, of this focus construction. Like other accounts on 'dou', Shyu treats 'dou' as a universal quantifier. Tsai (1994) made the observation that because of this construction, 'dou' and 'ye' "all" and "also" are both manifestations of a minimal binder variable pair like *al-*, such as 'all', 'always', and 'also'; in other words he treats both 'dou' and 'ye' as a universal quantifier.

'Zhangsan' is a singular term, therefore we ought to explain the use of 'dou' or 'ye' in such a sentence.

Let us start with 'lian' "even". 'Even' has been intensely studied over the past two decades or so (Horn, 1969, Fauconnier, 1975, Rooth, 1992, among others), and the combined insight on the nature of such sentences containing *even* can lend support to our semantic account of 'ye' and 'dou'. One theory of 'even', by Fauconnier (1975), is that 'even' invokes an implication scale in which the focused element by 'even' is at the lowest point of a vertical scale of likelihood of individuals who might donate money; the higher the individual is on the scale, the higher probability for donating money. The interpretation of the sentence derives from the fact that the least likely person such as Zhangsan, who is known as a miser and thus is put at the lowest point of the scale, has donated money, thus (41) implies that other people who are reputed to be more generous certainly have also donated money.

We will switch Fauconnier's vertical implication scale around by 90 degrees and reinterpret his implication scale as a set of events with a partial order $<$ meaning 'less surprising than' defined on them. So $e_i < e_j$ iff e_i is less surprising than e_j . We will take the function of 'lian' to be inducing such a partial order and pinpointing Zhangsan as the most surprising person to donate money; the event, call it e_j at which Zhangsan donated one thousand dollars has to occur at the right most position in such a partial order, namely it is the most surprising event, which entails that less surprising events of the sort have taken place.

The presence of 'dou' in (41) guarantees that the event argument refers to a sum of minimum donation events, backing up 'lian' in terms of providing the events on which the 'less surprising than' partial order can be defined.

The same thing can be said about 'ye'. The difference between 'ye' as used here and 'ye' in the previous examples is that here 'ye' is like 'dou' in terms of operating on an event variable, not a finite number of events.

We also note that if 'lian' is not used, there has to be a stress on the subject in order for the implication partial order to obtain. Thus one can conclude that the stress has the same function as 'lian' in focus sentences¹⁷.

3.3.2. 'A-not-A/A-or-not-A ... Dou/Ye/You'

There is another context in which 'dou' and 'ye' behave in a similar function and this time, they have another companion, 'you' "again, also". Again we will see that some lexical preferences have to be ignored, but that shouldn't blur the overall picture of what is going on.

The subject in this kind of sentence is the A-not-A or the choice type A-or-not-A construction, a very common construction in Chinese. This type of sentences induces universal quantification readings. The following examples show that 'dou' has the widest distribution of use,

¹⁷ Liu (1990:122) also takes stress into consideration for the interpretation of this type of sentences.

next comes 'ye', which again shows a preference for a negated predicate, and 'you', which is restricted to a rhetorical question type of sentence.

(42) *ta lai-(huozhe)-bu-lai dou xing.*

he come-(or)-not-come dou fine

'Whether he comes or not, either way is fine.'

(43) *ta lai-(huozhe)-bu-lai dou/ye bu guan wo de shi.*

he come-(or)-not-come dou/ye not concern I DE matter

'Whether or not he comes is none of my business.'

(44) *ta lai-(huozhe)-bu-lai you guan ni shenme shi ne?*

he come-(or)-not-come you concern youwhat matter Q

'What business is it of yours whether he comes or not?'

Or 'It's none of your business whether he comes or not.'

The universal quantificational reading in these constructions arises from the fact that the choices between A and not A exhaust the universe of possible events of the kind denoted by A¹⁸, hence the universal quantificational reading. And for either choice, the consequence is the same. Seen in this light, the predicate actually has to denote two, albeit identical, consequences, hence there is a sum operation on the event variable and such kind of subjects are well matched with 'dou/ye/you

¹⁸ This is an idea from Iatridou (1991). However, anticipating the discussion in the next section, one may also argue that the universal quantification reading comes from an implicit 'wulun' "no matter".

PRED'.

Obviously, with the universal quantification reading on the subject, there is a partial order between the subject denotation and the predicate denotation and in this partial order, the predicate denotation stands in the higher position, proving our HDP.

3.3.3. 'Wulun/Buguan/Renping...Dou/Ye'

Next we test our HDP in a type of sentences whose subjects are indefinite wh-phrases. Wh-phrases have been treated as polarity items (Cheng (1991), Y.-H. A. Li (1992),). Since they are variables, either universal quantification or existential quantification can be construed on them depending on the source of the quantification force. We will be only concerned with cases where the indefinite wh-phrase receives universal quantificational interpretation. Our inquiry of this construction begins with wh-phrase...'dou' to clarify the issues involved, and the generalization will be extended to include 'ye', which will be quite straightforward.

Consider (45):

- (45) a. *shei dou xihuan xiaogou.*
who dou like littledog
'Anyone likes puppies.'

- b. *shei chang zheishou ge wo dou ai ting.*
 who sing this-MW song I dou love listen
 'No matter who sings this song, I'd enjoy listening.'
- c. *ni mai shenme wo dou bu zaihu.*
 you buy what I dou not care
 'No matter what you buy I don't care.'

Contrary to the appearance that 'dou' might be the universal quantifier on the wh-words in (45), there is evidence that the universal quantification reading of the wh-words comes from lexical items such as 'wulun' "no matter". Consider (46).

- (46) a. *(buguan) ta shenmeshihou lai, women dou dei*
 no matter she what time come, we dou must
qu kan ta.
 go visit her
 'No matter when she comes, we have to visit her.'
- b. *(wulun) ni duome lei, dou yinggai ba zuoye*
 no matter you how tired, dou should BA homework
zuowan.
 finish
 'No matter how tired you are, you should finish your homework.'

- c. (*renping*) *ni shi shei, dou bu neng daren.*
 no matter you be who, dou not can hit-person
 'No matter who you are, you cannot hit people.'

The English translation of this class of words is "no matter ...". For convenience, 'wulun' will be used as the representative of this class of quantifier words. The examples above are used in S.-Z. Huang (1995a) to show that it is 'wulun' and its synonyms that give universal quantification reading to the wh-variables, even though they do not have to be phonetically present in the sentence.

Another piece of argument in favor of our contention that *dou* is not the universal quantifier on the indefinite wh-phrases comes from the fact that 'wulun' is like a distributive quantifier, similar to 'ge' "each" and 'meiyige' "every". This lexical property of 'wulun' prohibits it from being used with symmetric predicates:

- (47) a. **meiyige daibiao dou jian le mian.*
 every-MW delegate dou see LE face
 '*Every delegate met.'
- b. **ge ge daibiao dou jian le mian.*
 each-MW delegate dou see LE face
 '*Each delegate met.'
- c. **(wulun) shi shei dou jian le mian.*

no matter be who dou see LE face

*'Whoever it is, he met.'

We have argued for modeling 'mei- n' after EVERY and EVERY, associated with a skolem function, is defined in such a way that each member in the set denoted by its first argument has to be the minimum argument of the predicate whose denotation constitutes the second argument of EVERY. 'Wulun' (and the rest of such quantifiers) patterns with 'meiyige' in that it cannot co-occur with a symmetric predicate, suggesting that 'wulun' type of quantification is also an inherently distributive quantification. This leads to two conclusions. First, it is not 'dou' that universally quantifies the wh-words; if it were, one would expect that wh-word variables can co-occur with symmetric predicates with the help of 'dou', because we have seen that 'dou' can modify symmetric predicates such as 'meet' with definite plural subjects. Secondly, the obligatory presence of 'dou' should be attributed to the lexical property of 'wulun' type of quantification: The similarity between 'wulun' type of quantification and 'mei' suggests that the former should also be modeled after EVERY, which then requires skolemization. Because the skolem function requires the event variable in such sentences, 'dou's presence becomes obligatory.

Now that 'dou' is cleared from playing the role of a universal quantifier, we can simply argue that 'dou' in this type of sentences plays the same role as in 'mei- n' sentences where it is a sum operator on the event variable.

With 'dou' treated as a sum operator in the 'wulun' type of sentences, it paves the way for our understanding why 'dou' and 'ye' can be used interchangeably in this type of sentences: Since 'ye' is also a sum operator it follows that it can also function as the lexical operator that takes the event variable, thus introducing it into the logical translation where skolemization requires the presence of this variable.

The only difference between 'dou' and 'ye' in this context is that again 'ye' shows a preference for negated predicates, just as it does in the 'lian' construction.

- (48) a. *shei dou/ye mei jian guo Lisi.*
 who dou/ye not see GUO Lisi
 'Whoever it is has never seen Lisi.'
 Or 'No one has ever seen Lisi.'
- b. *shenmeshiqing dou/ye mei you.*
 what matter dou/ye not have
 'There is nothing (to be worried about).'
- c. *ni shenmeshihou lai dou/ye bu xing.*
 you what time come dou/ye not fine
 'No matter when you come, it won't be OK.'

As we have argued in the previous section, universal quantification on the subject induces a 'less than or equal to' partial order and once again

the denotation of 'dou PRED' stands on the right hand side in that partial order.

3.4. 'Dou' and 'Hai' "also, still"

By now, we have gained a sense of 'dou's relation to other verb particles such as 'ye' and 'you'. One other adverb that 'dou' shares some distribution with is 'hai' "still, even, in addition"¹⁹. The most basic meaning of 'hai' "still" is shown in sentence (49)

- (49) *ta haizai Nanjing.*
he hai at Nanjing
'He is still in Nanjing.'

But 'hai' can be found in a sentence with the meaning of "also" or "in addition" (the following example is from Liu (1995))

- (50) *ta haizuo le yige dangao.*
he hai make LE one-MW cake
'He also made a cake.' or
'In addition, he made a cake.'

¹⁹ For a diachronic study of the extension of the meanings connoted by 'hai', see Yeh (1995).

Liu (1995) proposes that 'hai' induces a partial order where the focus element marked by 'hai' assumes the higher value in the partial order.

For example, (52) is the formal apparatus for (51)

(51) *Laowang haizai kan dianshi.*

Laowang hai at watchTV

'Laowang is still watching TV.'

(52) a. $t_i, t_j \in T, t_i < t_j$ iff t_i precedes t_j . The set T with the ordering relation $< (T, <)$ is a poset (partial order set).

b. $F: E \Rightarrow \{\text{propositions}\}$ (E a set of entities)

$f \in F$ $f = \text{'X watch TV'}$, $e_i, e_j \in E$, $e_j = \text{now} \wedge e_i < e_j$

$f(e_j) = \text{X is watching TV now}$

c. $f, g \in F$,

$f: e_j \text{ -----} > P$

$g: e_i \text{ -----} > Q$

$Q < P$

This account says that for Laowang to be still watching TV now, he had to be watching TV at a time immediately preceding now.

3.4.1. 'A Bi B Dou/Hai... ' "A is even more ... than B"

In (53), 'hai' and 'dou' can be used interchangeably:

(53) *Wangwu bi Lisi hai/dou gao.*

Wangwu compare Lisi hai/dou tall

'Wang Wu is even taller than Lisi.'

For this sentence to be true, Lisi has to be tall to begin with and Wangwu is taller than Lisi. According to Liu's analysis of 'hai', 'hai' would mark the proposition P= 'Wangwu is tall' to have a higher value in a partial order of height, where the proposition Q= 'Lisi is tall' has a lower value. Given the partial order relation the truth of P entails the truth of Q.

We have a slightly different account of (53)²⁰. We believe that the partial order on individuals in terms of height is induced by 'bi' "compared with". In this partial order, Wangwu has the higher value than Lisi in terms of height. Without 'dou' and 'hai', the sentence simply means Wangwu is taller than Lisi, without the assertion that Lisi is tall too. The effect of 'hai' and 'dou' in a comparative sentence is that for them to be used, the event argument has to denote a plural set of events, since 'hai' and 'dou' in our account are sum operators on events; and that requires that there be plural events in the denotation of the event argument. Since these events are denoted by the event argument of the predicate, then at each event the property the predicate stands for must

²⁰ Jiang (1996) also discusses 'dou' in comparative sentences from a pragmatic point of view.

be true. We are in effect saying that the two events, call them e_i and e_j , are asserted and at e_i 'Wangwu is tall' is true and at e_j 'Lisi is tall' is true. This view of two asserted events in the comparative sentence like (53) entails that both individuals under comparison holds the 'tall' property, except that the individual referred to by the subject stands in the higher value position in the partial order of height, hence the reading 'Wangwu is even taller than Lisi', but Lisi is tall to begin with.

Now, back to HDP, we see that there is no problem. The denotation of the subject is a singleton set containing Wangwu and the denotation of the predicate contains at least Wangwu and Lisi, thus, the former is in a less than or equal to relation with the latter.

3.4.2. *'Jishi A Dou/Ye/Hai / You B' "Even if A, B"*

We have seen earlier that 'dou' can be used in a sentence with 'lian' "even". If 'even if' can be decomposed into 'even' and 'if', then what we have seen with 'even' should also be true with 'even if' and this is true. The corresponding expression for 'even if' is 'jishi' in Chinese.

- (54) *jishi ni shishijieshang zui youqian de ren,*
 even-if you be world most have-moneyDE person
wodou/ye/hai bu gen ni jiehun.
 I dou/ye/hai not with you marry

'Even if you were the richest person in the world, I wouldn't marry you.'

- (55) *jishi ta shiyige zuihan, Lisi dou/ye/hai yao*
even-if he be one-MW drunkard, Lisi dou/ye/hai want
xuan ta.
electhe

'Even if he is a drunkard, Lisi wants to elect him.'

- (56) *jishi ni ba jingcha jiao lai, you neng zenmeyang ne?*
even-if you BA police call come, you can what Q
'Even if you call the police over, what good would that do?'

All the adverbs, 'dou/ye/you/hai', can be used with 'jishi', again with 'you' being restricted to the rhetorical question type. The same analysis about sum operation and partial order advanced earlier should apply here.

3.5. 'Dou' and Interrogative Wh-Phrases

So far, all of our data involve interaction between 'dou' and some constituent to its left, such as in 'EVERY BOY dou LEFT' or 'EVEN Lisi dou CAME'. We call this the "orthodox" liaison between 'dou' and a "host" (the term "host" is used as a figure of speech without any semantic

content). But 'dou' can also be "related" to something to its right, although such an "unorthodox" liaison is limited to wh-questions, not a NP with a universal quantifier determiner, hence the contrast below:

- (57) *Lisi dou mai le shenme?*
Lisi dou buy LE what
'What are all the things Lisi bought?'
- (58) **Lisi dou mai le meiyijian dongxi.*
Lisi dou buy LE every-MW thing
'*Lisi all bought everything.'

First the question is, Should we provide a uniform account of the unorthodox cases and the orthodox cases of 'dou' sentences, and if yes, is our proposed account adequate enough to account for the contrast between (57) and (58)? The first question has been asked in the literature and some solutions have been attempted. We will review and critique the literature and argue that our proposed analysis of 'dou' is preferred because it is not only adequate in accounting to the unorthodox liaison between 'dou' and the wh-phrase to its right, but also adequate in accounting for the contrast between (57) and (58).

3.5.1. A Review of J. Li (1995) and X. Li (1995)

J. Li (1995) puts forward the argument that *dou* is a universal quantifier in both the case of 'wh-phrase...*dou* ...' and that of '*dou* ... wh-phrase'. He observes that the wh-phrase 'shenme' "what" shares three readings with a leftward host NP of '*dou*'. They are plurality, distributivity, and exhaustiveness. He uses the German lexical item 'alles' as a piece of supporting evidence that universal quantificational reading of wh-phrases is not isolated to Chinese. Li's argument for a uniform account of '*dou*' in both sentence types is well taken. The weakness of Li's article is that there is no syntactic or semantic account of how '*dou*' quantifies both leftward and rightward to something that is discontinuous from it. In particular, it is not clear how a universal quantifier account of '*dou*' would explain the contrast between (57) and (58). Li himself acknowledges that if somehow '*dou*' quantifies rightward as a universal quantifier, then it is unexpected that (58) is ungrammatical since '*dou*' can "quantify" leftward to a universally quantified NP, but he has no solution to this problem.

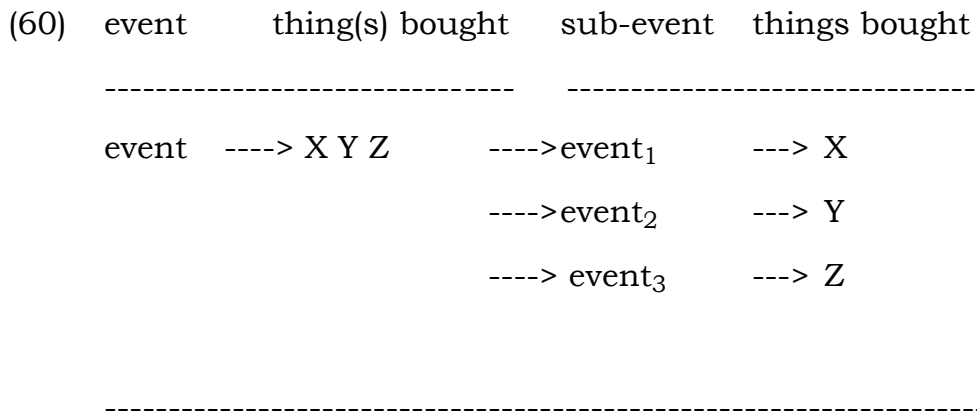
X. Li (1995) proposes an analysis of (57) based on Parson's (1991) theory of event quantification. It is an interesting but flawed account. He makes the same empirical generalizations as J. Li does about such a sentence, namely plurality, distributivity (with distributive predicates), and exhaustiveness. But the event quantification he proposes does not carry that through. Here is his central point. The formal representation of

a sentence like (57) is (59):

(59) For all x, x an event, for which y, y a thing, Lisi bought y in x.

However, this account as it stands predicts, incorrectly, that if one answers "Five onions", then there is a transaction of five onions for each purchase event. This is not the meaning of the answer. The answer means the total number of things Lisi bought are five onions.

X. Li recognizes this potential problem and offers a mechanism called "event slicing". Event slicing, according to him, consists of the scheme as shown below:



X Y Z can stand for an onion, a squash, and a pepper respectively. If there is one trip to a grocery store where these three things are bought, it is justifiable to think of the single trip as one big event that can be divided into three subevents.

But if this slicing is attainable, one would predict 'dou' can appear in the following sentence with the event slicing mechanism to divide the big purchase event into five separate subevents each of which involves the purchase of one book, hence allowing (61). However, as Li recognizes, such a sentence is not acceptable and is a problem to his account.

(61) **Lisi dou mai le wuben shu.*

Lisi dou buy LE five-MW book

The same problem holds for (58) since Li's account would also predict that that sentence ought be to fine given the slicing mechanism²¹.

3.5.2. A Predication Relation Account

Perhaps a good way to tackle this issue is to examine what the orthodox relation between 'dou' and its "host" is so as to arrive at an understanding of the underpinnings of the "unorthodox" relations. Our investigation will ultimately reveal that the seemingly unorthodox surface relation is just a reflection of the same principle that governs all good

²¹ Sung (1996) also made an attempt at accounting for 'dou...wh-phrase' under a universal quantifier reading of 'dou'. In addition to single occurrences of wh-phrases, he also considers multiple wh-phrases. However, the contrast between (57) and (58) still remains unaccounted for in his analysis.

'dou' sentences and that excludes (58) on principled grounds.

First, let us make an observation. If we put the "orthodox" 'dou' sentences together, as in (62), next to an "unorthodox" 'dou' sentence, as in (57), a very interesting pattern emerges. We show some samples.

(62) a. *meiyigeren/tamen/Zhangsan he Lisi dou zou le.*
everybody/they /Zhangsan and Lisi dou leave LE
'Everybody/they/Zhangsan and Lisi all left.'

b. *meiyige /neixie xuesheng wo dou xihuan.*
every-ME/those student I dou like
"Every student/those students, I like them all."

(57) *Lisi dou mai le shenme?*
Lisi dou buy LE what
'What are all the things Lisi bought?'

The two types can be abstracted into the following representations, irrelevant syntactic details aside:

(62)' [Topic_j [NP_i [VP x_i dou V y_j]]]

(57)' [Q_j [NP_i [VP x_i dou V y_j]]]²²

²² *y* may be a wh-variable, a trace, or a resumptive pronoun or anything that seems to be able to stand in for an open position within the VP.

The parallel between (62)' and (57)' makes it clear that whatever the underlying mechanism it is, it is operative in both orthodox and unorthodox 'dou' sentences²³. We take the facts to mean that use of 'dou' has something to do with an open place within the 'dou VP' that is coindexed with the "host" constituent. In languages like Chinese and English, a subject can raise out of VP, assuming the VP internal subject hypothesis and subject raising for both languages (C.-T. J. Huang, 1993); a topic and a wh-phrase can also be outside of VP; and raising or movement of these kinds always go leftward. All of the raised constituents forge a relationship with a co-indexed variable inside the VP one way or another. What is crucial in (62) is the fact that there is an open position inside the predicate, which allows the VP to be predicated of its subject or topic argument²⁴. Viewed this way, 'dou PRED' is really forming a predication relation with its "host"²⁵.

To assimilate (57) to (62), we treat the wh-phrase and the rest of the sentence as forming a subject-predicate relation. In order to do this, we will assume the possibility of layers of predication within a single sentence. Layers of predication have been argued for by Heycock (1991) and could presumably apply to Chinese as well. Heycock's main points are that predication is a syntactic primitive, independent of θ -role assignment; and that any [+V] XP can be predicates, thus claiming that

²³ We are not particularly interested in the question where exactly in the VP that 'dou' can appear. For relevant discussions, see Chiu (1990) and Cheng (1995).

²⁴ This is not a new observation. Tsai (1994) also treats topic-comment as a predication relation.

²⁵ We presented this idea in S.-Z Huang (1996) at the Fifth International Conference on Chinese Linguistics held in June 27-29, at Tsing Hua University, Taiwan, where J.-W. Lin presented an idea very similar to this independently.

"verb movement to Comp in a number of Germanic languages results in CP also functioning as a predicate: as predicted, in such cases CP may also have an expletive subject" (ibid. p.32); and that "a single clause may consist of multiple layers of predication.... where other principles are satisfied, the subject of adjacent layers may differ" (ibid. p.33).

We have of course gone even beyond Heycock's original range of data by claiming that a wh-question and the rest of the sentence also form a subject and predicate relation. However, such a relation is predicted by her criterion that [+V] XP can function as a predicate. Take English as an example. In English, wh-movement results in moving the auxiliary verb to Comp when the wh-phrase lands in the Spec of CP. The auxiliary verb under Comp entails that CP carries the feature [+V], the same way as the verb second phenomenon in other Germanic languages does. With the wh-phrase in the Spec of CP and CP carrying [+V] feature, the CP functions as the predicate that takes the wh-phrase as its subject. Such a basic semantic relation, we argue, should be considered as part of wh-question sentences in Chinese as well, although Chinese is a wh-in-situ language. Thus we propose to call the subjects, topics, and interrogative wh-phrases in the afore-mentioned examples subject*.

Here is our generalization on the structural condition on 'dou'.

(63) **Structural Condition on 'Dou' (SCD)**

There is a predication relation between the 'dou VP' and its host constituent. The host constituent is the subject* of the 'dou VP'. A constituent is the subject* in a sentence if it is outside VP, m-commands and is coindexed with an open place (a free variable) within the VP. The open place allows the VP to denote a set of elements that are minimum arguments of which the VP holds true. In other words, the subject* is the potential candidate saturating the variable position within the VP. If a constituent does not meet the conditions specified above, it cannot be the subject* of 'dou VP'.

SCD is observed by the sentences in (62) for obvious reasons: The hosts of 'dou' are either the syntactic subject or topic, thus they are automatically subjects*.

SCD rules out (58) because in (58), 'meiyiben shu' "every book" appears in the canonical object position, therefore there is no variable and the VP cannot be predicated of it, thus 'dou' cannot be used in this sentence. Besides, we have said in Chapter 2 that the skolem function associated with EVERY has to be inside the c-command domain of EVERY; if the event variable is needed for skolemization, as is the case in (58), for 'dou' to be c-commanding 'mei' certainly makes the event variable disqualified for skolemization.

Even if one assumes quantifier raising of 'meiyiben shu', it is still within the VP (Aoun and Li (1993), Ernst (1996)), therefore not meeting the structural condition on 'dou', which requires the subject* to be outside of the VP²⁶.

Next, let us see how (57) fares under SCD. For our purpose, we will adopt Cheng (1991), Aoun and Li (1993), and Tsai (1994) and others in taking the wh-question in Chinese as basically a Question operator and a variable relation, where the in-situ wh-phrase introduces the variable, following Cheng (1991) and Y.-H. A. Li (1992), and assume the following representation for (57) at LF, using English gloss for ease of exposition:

(64) [Q_i [Lisi dou bought wh-phrase_i]]

But the question operator cannot really be the subject* that the 'dou VP' wants, since it is not a set-denoting element. Nevertheless, [Lisi dou bought wh-phrase_i] is an open formula with the wh-phrase corresponding for a variable in the logical translation. We do not think (64) is a problem to our SCD if we consider the semantics of questions more closely. Note that as far as the 'dou VP' is concerned, it is subject*less in (64). But it does have a potential subject*.

To see that, we should return to the idea of partial order that a 'dou VP' is always associated with, according to our HDP. Recall that a partial order such as \leq is a disjunction of 'less than or equal to', where the disjunction is true if either of the disjuncts holds. We have seen

²⁶ I thank Tom Ernst for discussing this point with me.

earlier that in some partial order relations, only the 'less than' relation holds. Here, we must recognize that the partial order induced by the 'dou VP' in a wh-question sentence is an 'equal to' relation. In other words, to identify the answer is to identify the denotation of the 'dou VP' in this sentence. Hence, the force of the question operator can be viewed as asking for the denotation of the 'dou VP'.

What could be the denotation of the 'dou VP' then? We know that 'dou' is a sum operator on the event variable; so it generates a maximal plural event comprising minimal events, which requires that the predicate denote the maximal number of things that have the 'Lisi bought' property.

Furthermore, following Aqvist (1965), Belnap (1969), Lang (1978), Wachowicz (1978), and Ernst (1994)²⁷, we assume that the question operator can be thought of as an imperative predicate that means 'Tell me x!', x being the variable provided by the wh-phrase.

Combining the semantics of the 'dou VP', namely the partial order, and that of the question operator, we get the sense that this sentence solicits an answer that includes the things each of which bears a 'Lisi bought' relation. The effect of 'dou' in such a sentence is the same as has been examined before.

This takes us back to the question what is the subject* of the 'dou VP' in (57). Now we know: The subject* in (57) remains to be identified. But it is not a ghost subject*, for once the denotation of the 'dou VP' is determined, so is the identify of the subject* since they have an 'equal to'

²⁷ We thank Tom Ernst for pointing out the reference to us.

relation. Following our standard practice with a 'dou VP', its subject* appears on the left hand side in the partial order =, while the predicate denotation set takes the right hand position in a schema like the one below. The question operator is translated as Tell Me!.

$$(65) \quad \text{Tell Me! } x, \{x\} = \{y \mid \text{AT}(\text{Lisi-BOUGHT } y, e) \wedge \text{THING}(y) \\ \wedge \text{DOU}(e, \text{Lisi-BOUGHT } y)\}$$

The first step in understanding (65) is to collect all the minimum events in which Lisi bought y and sum these events into a plural event (sum of events). This sum of minimum events performed under 'dou' dictates that all the minimum entities which have the 'thing' property and the 'Lisi bought' property at the minimum events have to be included in the predicate denotation set. Thus, the reading 'What are all the things that Lisi bought' in (57) is represented semantically without treating 'dou' as a universal quantifier on the wh-phrase.

Without 'dou', the sentence should have an interpretation like the following:

$$(66) \quad (\exists x) (\text{THING}(x) \wedge \text{Lisi-BOUGHT}(x) \wedge \text{Tell Me!}(x))$$

With 'dou' absent in the sentence, there is no sum operation on the events and no partial order on set relations. With the existential quantifier that quantifies over the wh-variable the question operator

seeks an answer that contains at least one element that has the 'Lisi bought' property.

A remaining problem of the SCD is that it wrongly predicts that one can say (67), in which the subject wh-phrase is interrogative, when in fact it is an unacceptable sentence²⁸:

- (67) **shei dou lai le?*
who dou come LE
'Who are all the people that have come?'

For the intended meaning, one has to say:

- (68) *dou you shei lai le?*
dou have who come LE
'Who are all the people that have come?'

So the question is, Why cannot (67) mean "The potential subject* in (67) has an 'equal to' relation to the predicate denotation, so Tell Me! the denotation of 'dou lai le'"? Apparently, for the wh-phrase to have an interrogative construal and be the subject* of the 'dou VP', it has to be inside the VP (or more accurately, to the right of 'dou'). This is a peculiar fact since in (62), the subjects of the sentences are also subjects*. Why cannot a wh-phrase be both at once? We will offer a tentative but radical

²⁸ We have seen earlier in this chapter that when the wh-phrase in the subject position obtains universal quantification reading, resulting in the meaning 'Everyone has come', it comes from the implicit universal quantifier 'wulun' "no matter".

suggestion here: Perhaps 'dou' is also associated with a skolem function in constituency question sentences where the denotation of the wh-phrase is made to depend on the denotation of the predicate. If this is on the right track, then it is not surprising to find the wh-phrase to be obligatorily to the right of 'dou': It has to be c-commanded by 'dou' in order to be skolemized²⁹.

This view of the function of 'dou' in constituency question sentences seems to be correct in the direction it is taking, even though more details have to be worked out. One prediction it makes is that if 'dou' is not used in such sentences, there is no skolemization and no partial order between the to be identified-subject* and the predicate, so the answer is not made to depend on the denotation of the predicate. In such a sentence, an existential quantification reading obtains on the wh-phrase, as illustrated below:

(69) a. *shei lai le?*

Who come LE

'Who came?'

b. $(\exists x) (\text{PERSON}(x) \wedge \text{CAME}(x) \wedge \text{IDENTIFY!}(x))$

We will leave the details of this proposal open for future research.

²⁹ For an alternative analysis of sentences like (68), see Zhang (1996).

3.6. Summary: Tense and 'Dou'

Our analysis of 'dou' treats it as a sum operator that takes the event variable as its argument. This analysis of 'dou' achieves two purposes. First of all, it lexically introduces the event variable into the formal representation, which facilitates skolemization needed for EVERY. Secondly, the sum operation results in the forming of a plural event that is the lowest upper bound, $\cup E_{PRED}$, in the partial order for events and we put the effect of this result into a hypothesis (i.e. HDP), which says that 'dou' marks the predicate denotation as standing in the higher value position in a partial order, which is either induced by 'dou' or by something else in the sentence (e.g., e.g., EVERY also induces a partial order).

The rationale behind this treatment of 'dou' is that it fulfills a function in Chinese that is fulfilled by the tense operator, which is a morphologically overt element in English, because Chinese lacks tense. If we originally recognize the role the tense operator in English and 'dou' in Chinese share to be confined to morphologically/lexically introducing the event variable at the first stage of interpretation, in this chapter we have had a chance to see that the similarity between tense and 'dou' seems to be more than just that. At least we have seen that tense, which induces a partial order on T, a set of points or periods on time, is matched by 'dou', which induces a partial order on events. Something more should be said about that match, although at this point, we do not have a well-articulated theory on that.

Chapter 4

Constraining the Event Variable

4.1. Introduction

In Chapter 2, we made a skolemized definition of EVERY, after which both 'every' and 'mei' are modeled. And we have seen that the definition works quite well in capturing the basic distribution patterns of both determiners. In this chapter, we would like to return to the two assumptions made in Chapter 2 that have some important implications about the way the Chinese language works.

The first assumption to be revisited is the claim that 'dou' is needed to lexically license the event argument for skolemization in the scope of 'mei', while no such lexical item is necessary in English for 'every' because of the overt and systematic use of tense. If this is true, it would mean that in Chinese, there could be a host of adverbial phrases whose role in a sentence may be tightly related to the licensing/constraining of the event argument, given that there isn't a single lexical or morphological element in the VP in Chinese that does what tense does in English. This way of looking at adverbial phrases has certainly elevated the importance of adverbial phrases in Chinese for the well-formedness of sentences, if we can show that in Chinese the event

variable relies more heavily on adverbial phrases than it does in English. We will show just that in this chapter.

Another assumption we made in Chapter 2, following Heim (1982), is that existential closure applies at the outside of a formula, meaning it applies at the sentence boundary, thus it always takes wide scope with respect to quantifiers inside the formula. This assumption entails that there will be no unbound variables left in a formula because any variable in a formula that is not otherwise bound will be bound off by this operation, if it is lexically licensed, given the first assumption. This predicts that in Chinese indefinite noun phrases can take the subject position as they can take the object position, because they are lexical elements, thus, the variable they introduce are lexically licensed. This is against the general perception that indefinite subjects are not well-suited for the subject position in Chinese (Li and Thompson (1981), among others), but there is reason to believe that there is a better way to account for the apparent problem of using indefinites in the subject position.

In this chapter we hope to show that licensing the event variable by the adverb 'dou' is not an isolated phenomenon; there are quite a few classes of lexical items that can license/constrain the event variable, thus making the event argument available for quantification. Furthermore, we can show that an indefinite subject NP in Chinese is not itself a problem in terms of carrying an unbound variable. Existential closure takes care of that. The real issue, we argue, has to do with the event variable not automatically constrained in Chinese.

In Section 4.2., we give a brief presentation of Parsons (1990), for it provides a general framework on the interaction between adverbial modifiers and the event argument from which we can borrow some useful concepts, if not his system as a whole. In this section, we propose a hypothesis on the constraining of the event argument (HCEA) as a condition on event quantification in general.

Section 4.3. examines the usefulness of HCEA by way of reviewing Fan (1986), Lee (1986) and our own work in S.-Z. Huang (1995b), which all deal with the role adverbial modifiers play in sentences in which indefinite/numeral NPs appear in the subject position. Using Parsons classification of adverbial modifiers, which is partially based on Jackendoff (1972) and Bellert (1977), we present a systematic examination of the classes of modifiers that can function as constrainers of the event argument. It is shown that indefinite/numeral NPs as subjects are not problematic in precisely those contexts in which the event argument can be argued to be constrained by some proper lexical elements, suggesting that the numeral NPs themselves are not causes for unacceptability. It is having an unconstrained event argument that results in an unbound variable in a logical representation.

The issue of differences among the potential constrainers is taken up in this section and we shall argue that this may be attributed to different selection restrictions or "sortal correctness" the quantifiers put on the event argument.

After presenting evidence to support the claim that lexical constraint of the event argument is a productive operation in Chinese for

event quantification, we concentrate in Section 4.4. on a particular sentence type--conditional sentences in Chinese-- to further illustrate the applicability and in some cases advantage of the proposed HCEA and skolemized definition of EVERY, after which, we show that universal quantification manifested in conditional sentences can be modeled.

In Section 4.5. we present an open issue for future study.

4.2. Parsons (1990)

Concerned with how to capture the metamorphosis from what a verb stands for to what a sentence stands for, Parsons (1990) proposed logical representations of simple English sentences, elaborating on the interactions of the event variable with tense, time- and locative-adverbials, arguing that the latter provide constraints either on the event variable or on a time variable introduced by a default form of quantifier present in any simple sentence (ibid. p. 209). The end result of such constraining on the time variable and event variable is that a sentence like 'Mary hit Fred' stands for a particular instance of hitting while the unconstrained verb 'hit', like a common noun, stands for a kind of action.

Let us take a closer look at Parson's logical representation of simple English sentences. The following is an abstract logical representation of a simple sentence containing a time variable and an

event variable, a subject and tensed verb, temporal adverbials, and adverbial verb modifiers:

- (1) Frame $[(\exists \mathbf{I})[\text{Tense}(\mathbf{I}) \wedge \text{Time-Constraint}(\mathbf{I}) \wedge (\exists e)(\exists t)[t \in \mathbf{I} \wedge \text{Verb}(e) \wedge \text{Role}(e)^n \wedge \text{Mod}(e)^m \wedge \text{Cul}(e,t) \wedge \text{Temporal-Mod}(e)]]]$

Frame adverbials are the ones that set the context within which the rest of the sentence is interpreted. They include phrases like 'during the war', 'in China', etc. Tenses are interpreted in the logical form as predicates on the time variable introduced by a quantifier that comes in the default form of a simple sentence, constraining the period of time to the past, the present, or the future. Time-constraint adverbials, such as 'yesterday', further restricts the time variable already constrained by tense. Role stands for thematic roles such as Agent or Theme. Mod stands for mode of action such as 'violently', and Cul stands for the culmination of an event at time t.

If there is more than one temporal adverbial phrase, all of them constrain the same variable in the same way. For instance, (2) is represented as (3)

- (2) Yesterday at noon, Brutus stabbed Caesar

- (3) $(\exists \mathbf{I})[\mathbf{I} < \text{now} \wedge \mathbf{I} \subset \text{Yesterday} \wedge \mathbf{I} \subset \text{Noon} \wedge (\exists e)(\exists t)[t \in \mathbf{I} \wedge \text{Stabbing}(e) \wedge \text{Agent}(e, \text{Brutus}) \wedge \text{Theme}(e, \text{Caesar}) \wedge \text{Cul}(e,t)]]$

Temporal modifiers can be a predicate that takes the event variable as its argument in the logical form. So in (4),

(4) I ran at noon.

'at noon' is the predicate on the event variable in the logical form as given in (5) (ibid. p. 210):

(5) $(\exists I) [I < \text{now} \wedge (\exists e) (\exists t)[t \in I \wedge \text{Running}(e)$
 $\wedge \text{Agent-Theme}(e, \text{me}) \wedge \text{At}(e, \text{noon}) \wedge \text{Cul}(e, t)]]$

Three comments can be made on Parson's logical representation of a simple sentence. First, because tense is obligatory in English, and tense constrains the time variable, one can conclude that the time variable is obligatorily constrained in English.

The second comment is that Parsons seems to have given a structurally based different treatment to the temporal adverbials. The preverbal ones are represented in the logical form to constrain the time variable while the post verbal temporal ones take the event variable as an argument. However, as far as we can tell, constraining either of the two variables will result in the same interpretation of the sentence, because having the time variable constrained to a particular period of time, such as 'at noon yesterday', or having the event variable predicated by the same phrase amounts to the same interpretation that a kind of event, say 'running', took place in a period of time in the past, and that past

period of time fell within the period denoted by 'yesterday', in particular, it was at noon yesterday that such an action took place. For our purpose, we do not see the need to posit two variables within the same sentence and we shall go back to Davidson's original postulation and just have the event variable as the extra argument position in the logical representation of a sentence.

The third comment has to do with the role of the predicate itself in terms of constraining the event argument. Parsons explicitly treats the predicate itself as a predicate of the event argument, as we can see in (3). However, we do not believe that a sentence predicate itself performs a 'constraining' function on the event variable. Had it been sufficient to use the sentence predicate to constrain the event variable, we would have been able to obtain the instantiated event reading from a sentence in which the sentence predicate is not modified by any of the spatiotemporal elements, including tense. This is obviously false, since one cannot say 'He cry' in English and have it mean a specific instance of 'crying'. One way out of this potential confusion is to stipulate, as we did in Chapter 2, that the event argument is introduced by a function we call $AT()$, not the predicate itself, and have the truth of the sentence be restricted to the event argument. The event argument itself is at least always constrained by tense, if not simultaneously by other elements in English. Simply put, the syntactic predicate itself is necessary but not sufficient for constraining the event argument.

Parsons aims to show how to use a fully articulated logical formalism to represent simple English sentences in terms of their metamorphosis from a simple verb, which stands for kinds of events, to sentences, which stand for particular instances of such events. His theory on events in the semantics of English, we believe, can be interpreted to mean that an unmodified sentence predicate takes as one of its arguments an un-constrained event variable. And an un-constrained event variable denotes a kind of event, not particular instances of such an event. Those spatiotemporal elements in a sentence, including tense, semantically affect the event argument by syntactically modifying the sentence predicate. More concretely, the spatiotemporal elements provide constraints on the event variable in the logical representation so that the sentence as a whole stands for a particular instance of the event of the kind the sentence predicate stands for. As we will see, this insight plays an important role of guiding our investigation of quantification of events in Chinese. We want to use his insights to advance our own work while not necessarily adopting his formalisms into our system. By illustrating Parsons (1990) we can gain a better sense of the roles tense and spatiotemporal adverbial phrases play in constraining the event argument. For Parsons, the focus is the difference between the kind and the particular, with the latter reading made possible by existential quantification of constrained time variables and event variables, for us, the concern is how to constrain the event argument for quantification in general.

Now, we would like to turn the previous points into a working hypothesis:

(6) Hypothesis on Constraining the Event Argument (HCEA)

The event argument (e-argument) introduced by function AT and carried by a syntactic predicate must be properly constrained by some morphologically or lexically overt elements and only an overtly constrained e-argument is available for quantification at the first stage of interpretation.

Note that this working hypothesis is a re-interpretation of the generalizations on the "underlying event structures" (Parsons) of simple sentences based on the studies of English, and therefore it does not in any essential way add anything new to our understanding of English. Its real usefulness, however, lies in its ability to explain some facts in Chinese. We hope to show in this chapter that constraining of the e-argument (or e-variable, as we may call it alternatively) or lack of which in Chinese may prove to be at the core of a number of cases involving quantification. The notion of 'proper constraining' will remain an intuitive notion, but will become clearer as we proceed. The lexical elements that seem to perform the proper constraining on the e-variable include but are not limited to, time, location, and manner adverbial phrases, 'dou', 'you' "have", alethic modal 'yinggai' "ought to", the adverb 'jiu' meaning "then, consequently", etc. Our investigation of e-variable constraining will

not only strengthen our position that the adverb 'dou' is needed to lexically constrain the e-argument for skolemization, but also shed some light on the differences between quantified subjects and definite subjects in Chinese.

4.3. Constraining the e-argument for Quantification

4.3.1. Adverbial Phrases, 'You', and 'Dou' as Constrainers

A generally accepted observation about Chinese is that Chinese does not have tense¹. HCEA predicts, then, that in Chinese, the e(vent)-argument introduced by AT has to be constrained by some other appropriate elements or the logical representation for the sentence will be ill-formed with an unbound variable. The following data show that this prediction is indeed born out.

- (7) a. **yige nan tongxuetiao le wu.*
one-MW male student dance LE dance
'A male student danced.'
- b. **yizhi laomao si le.*
one-MW oldcatdie LE
'An old cat died.'

¹ It is generally believed that Chinese does not have systematic tense marking. However, Chiu (1993) argued for a syntactic Tense Phrase projection. For the opposing view, see Tsai (1994), and Cheng & Tang (1996).

Our account of (7) based on HCEA deviates from the general view that (7)'s unacceptability is attributable to the indefinite subject as producing a variable that is not bound (Li and Thompson (1981), Cheng (1991), Tsai (1994)). But we are not without company. Lee (1986:82-83), attributing the observation to Fan (1986), presented evidence to show that the following sentences all contain topics (which can be assimilated to Parsons's "frame adverbials") in addition to the numeral subjects, and the topics can "signify a time or location of a group of individuals", thus allowing the numeral NPs to be "referential" (the sentences in (8) are Lee's (237a-d)).

- (8) a. *Beijing sanshige qingnian fangwen le Riben.*
 Beijing 30-MW youth visit LE Japan
 'Thirty youths from Beijing visited Japan.'
- b. *xili, liangge jiaoshou hen xihuan Zhangsan.*
 department,two-MW professor very like Zhangsan
 'In the department, two professors like Zhangsan very much.'
- c. *ganggang, yige ren lai zhao ni.*
 just now, one-MW person come look-for you
 'Just now, someone came to look for you.'
- d. *zuotian, yige gongren congchuangkou diao*
 yesterday, one-MW worker from window-seat fall

le xialai.

LE off-come

'Yesterday, a worker fell down from a window seat.'

In S.-Z. Huang (1995b), we further noted that when the VPs are modified by time expressions, locative expressions, or manner adverbs, sentences with indefinite NP subjects are fine, as shown in (9)-(11):

(9) *yige nan tongxue xianzai zheng zai ner tiaowu.*

one-MW male student now right at there dance

'A male student is dancing right now.'

(10) *yige qingjie gong zai women xuexiao de*

one-MW clean person at our school DE

tushuguan faxian le yitiao she.

library find LE one-MW snake.

'A janitor found a snake inside the library at our school.'

(11) a. *yige nianqing gongren feikuaide ba neige xiaohai*

one-MW young worker fly-quick Bthat-MW child

cong kache dixia la le chu lai.

from truck underneath pull LE out come

'A young worker pulled out the child from underneath the truck swiftly.'

b. *yige nuren qiaoqiaode di gei le wo yizhang*
one-MW woman secretly passgive LE I one-MW
zhitiao.

note

'A woman secretly passed a slip of paper to me.'

c. *yige jingcha ehenhende cong yige*
one-MW policeman menacingly from one-MW
jingtong li chong chu lai...
police-pagoda inside charge out come...

'A policeman menacingly charged out of a police traffic
control station...'

Now, we may have an explanation of all these facts in a principled way. Under HCEA, sentences in (7) are ungrammatical because there is nothing in these sentences to constrain the e-arguments, which then cannot be bound off by existential closure, thus the sentences are ruled out for containing unbound variables². In contrast, sentences in (8)-(11) all have some phrases, including what Fan calls 'topics', that provide time, location, or manner to constrain the e-argument and consequently they are all acceptable³.

² The aspect marker LE, indicating completion of action, does not seem to have the same kind of effect as time expressions, suggesting that aspects do not perform the same function as tense and time expressions do in terms of E-argument constraining.

³ This is different from the original interpretation in S.-Z. Huang (1995b), where we take the adverbial phrases as providing a time index. We believe that the current proposal, namely HCEA, is a better account.

The reason we can treat the indefinite subject NPs as unproblematic in these sentences is that they are, in our system, existentially bound off by existential closure⁴, which we have claimed to take the wide scope with respect to any quantifiers in a formula⁵.

Let us consider Cheng's (1991:129) position on indefinite subjects in Chinese. Cheng adopts Diesing's (1990) mapping hypothesis, which is an algorithm that splits a simple sentence into two parts to represent Kamp/Heim's tripartite structure for quantification in a schema such as 'Q [Restrictive Clause] [Nuclear Scope]'. According to the mapping hypothesis, all materials from VP are mapped into the nuclear scope, and anything above it is mapped into the restrictive clause. Diesing stipulates that existential closure applies at the VP boundary, unlike Heim (1982), who takes it as a discourse operation.

Cheng treats the indefinite subject NPs such as the ones in (7) as outside VP so that they introduce a variable that is not bound by existential closure⁶. The rescuing device for such sentences is 'you' "have", which Cheng takes as an existential quantifier, so that 'you' can

⁴ See the following references for recent attempts to account for the use of indefinite and/or numeral noun phrases in the matrix subject position in Chinese: Y.-H. A. Li (1996), Jiang & Pan (1996).

⁵ Existential closure on the indefinite subject variable automatically accounts for Fan and Lee's intuition that the indefinite subjects in (i) are 'referential', which is equated with specificity in their system (Lee, 1986:74). The difference between Fan/Lee and the proposed account here is that for them, the numeral subjects are problematic unless the "topics" seen in (i) are used; for us, the variables introduced by numeral subjects are always bound off by existential closure, they are thus not problematic to begin with.

⁶ Lowering of the subject is not an option in Chinese in her theory. See Tsai (1994) for a Copy Theory account of the same set of facts.

existentially bind the variable introduced by the indefinite subject, as shown in (12) below⁷:

- (12) **you** *yizhi laomao si le.*
have one-MW oldcatdie LE
'An old cat died.'

Cheng's account works very well with the contrast between (7) and (12). But it is not clear how to apply it to account for the grammaticality of (8)-(11), where there is no overt element that can provide existential quantification, nor is it obvious that the indefinite subject NP is brought within the reach of E-closure when the adverbial phrases are present.

Our account of the contrast between (7) on the one hand, and (8)-(11) on the other, has shifted the focus of investigation of the ungrammaticality of sentences like (7a) and (7b) from the subject to the predicate, arguing that ungrammaticality of (7a) and (7b) is a result of the violation of HCEA. (8)-(11) show that once the event argument is properly constrained by the preverbal adverbial phrases to time, location, or manner, then the sentences are no longer unacceptable.

What we need to explain is (12). We propose to take 'you' to be a lexical item that can properly constrain the e-argument by presenting the existence of such an event into the discourse. While spatiotemporal and manner adverbial phrases constrain an e-argument by providing an

⁷ For a fuller discussion on 'you', see C.-T. Huang (1987), and for a much briefer discussion, see Tsai (1994:130-131). Lee (1986:76) also talks about the effect of 'you' on numeral subjects but under terms different from Cheng's.

instantiated dimension to the event, 'you' has the unique function of presenting an event as instantiated, to capture the "presentational" nature of 'you' sentences. Formally, we will translate this function of 'you' as PRESENTED that takes the event variable as its argument. Under such an analysis, the logical translation of (12), for instance, is (13)

(13) $\exists x, y (\text{OLD CAT}(x) \wedge \text{PRESENTED}(y) \wedge \text{DIED}(x, y))$

(7b) differs from (12) in that there is no 'you', nor is there any other overt morphological or lexical element to constrain the e-argument, as a result the sentence violates HCEA.

To take 'you' as constraining the e-variable, not an existential quantifier on the indefinite NP, we predict that the following sentence is fine, which is true.

(14) **you** *yitian*, *yige* *xuesheng* *dui wo* *shuo*...
 have one-day, one-MW student to me say
 'One day, a student said to me...'

In (14), there are two preverbal indefinite phrases, but only one 'you'. This is predicted to be correct by HCEA because the function of 'you' is taken to be constraining the e-variable; since there is one e-variable per simplex sentence, one 'you' is enough. Under our account, the two variables lexically introduced into the logical translation by the indefinite

There is an apparent counterexample to the claim that (7a,b) are bad because the e-argument lacks proper constraint in these sentences. For instance, in the following sentence, none of the overt lexical adverbial elements appears in the sentence, and yet the sentence is fine. The only noticeable difference between (15) and (19) is that the latter has a referential subject NP.

(19) *Lisi bingle.*

Lisi sick LE

'Lisi is sick.'

Here, we would like to make use of the referentiality of the proper names, pronouns and definite NPs such as 'neige xiaohai' "that child" and entertain the idea that this class of noun phrases introduce a predicate which we will call EXIST by virtue of the fact that they refer to entities whose existence in the world is taken to be established. We stipulate that this class of NPs carries a spatiotemporal index that will always put them in a contextually defined spatiotemporal location. For instance, the name Martin Luther King will not only refer to the great American civil rights leader but will also invoke the era in which he lived as in a sentence like 'Dr. King met with the other civil rights leaders in a city in Mississippi', unless a specific or different time period is explicitly noted as in 'Dr. King stands for one of the best ideals for the human kind', where the present tense defies taking Dr. King to be a great civil rights fighter only in his own life time. We will take this spatiotemporal index

as the source for the predicate EXIST and claim that this predicate can take the event variable as its argument. Once predicated by EXIST, the e-argument is then made available for existential quantification in (18).

The intuition behind this idea in part can be traced back to Parsons (1990). The transition from the kind of event reading associated with a verb to the particular event reading associated with a simple sentence can be seen as a process of adding layers of constraints to give specificity to the event. This process can also be characterized as "anchoring down" the event to a specific spatiotemporal location. Tense, time and locative expressions no doubt can perform this function on the verb. But proper names, pronouns, and definite NPs can also be viewed as anchoring the event down to a (contextually) definable time and location if these noun phrases can be used in a conversation at all, because the interlocutors all have to be assumed to know the referents of these noun phrases or there is a break down of communication. For instance, we cannot start using the proper name Sun Zhong-Shan to the general audience in America without first describing him, because most people in America do not know that he was the great leader of the revolution that eventually led to the downfall of the Qing Dynasty in 1911. But to most Chinese of certain age, we can start a sentence with his name and begin talking about the events he was involved with in Chinese, and by talking about him, a certain era (end of 19th century and beginning of 20th century) would be evoked to set the "frame" of the

events, in Parsons term⁹, even though Chinese has no formal tense marking. Indefinite subjects, lacking the spatiotemporal index, will not help the predicate in this regard. Use of indefinite subjects thus requires that the sentence predicate come with the e-argument constrained or the sentence contains an unbound variable, which is not allowed by general rules.

Here we would like to make an observation about quantified subjects vis-à-vis definite subjects. If we put the facts together, a general pattern emerges: Definite NPs in Chinese have the autonomy in terms of distribution, particularly in the subject position, that quantified subjects, be they universal or existential (via existential closure) do not have, as we can see from the following examples:

- (20) a. *neige xiaohai zou le.*
 that-MW child leave LE
 'That child left.'

⁹ We would like to note that the same class of noun phrases in the object position does not seem to have the same kind of effect on the E-argument. For instance, if the subject is indefinite, and the object is definite, but there is no other lexical elements that can constrain the event argument, the sentence is still not good, as is shown below:

- (i) **yizhi gou yao le zheige piqiu.*
 one-MW dog bite LE this-MW ball
 'A dog bit this ball.'

There is no reason to say that this class of NPs does not carry a spatiotemporal index when used in the object position. One plausible explanation of this discrepancy is that it is a matter of predication between the VP and the subject NP. An object NP is part of the VP that forms a one-place predicate that takes the subject NP as the external argument. We can stipulate then that the predicate EXIST introduced by the relevant NPs in the object position cannot take the E-argument as its argument. We do not have any thing more specific to offer about this at this point.

b. **yige* *xiaohai* *zou* *le*.

one-MW child leave LE

'One child left.'

c. **meiyige* *xiaohai* *zou* *le*.

every-MW child leave LE

'Every child left.'

We attribute the dichotomy between the referential noun phrases and quantified noun phrases to the former providing an EXIST predicate to constrain the e-argument that the latter group lacks.

One issue remains to be resolved. Recall that we said in Chapter 2 that there are two stages of interpretation and a non-lexically introduced variable can wait for interpretation at the second stage. If so, why have we attributed the problems in the two sentences in (7) to be related to having an unbound e-variable? If nothing hinges on this unconstrained variable, why can't it wait for existential binding at the second stage? We think the explanation has to be linked with indefinite subjects, although we still maintain that the indefinite subjects themselves are not problematic. The pattern of behavior suggests that when the existential closure is invoked at the first stage of interpretation, as it is for binding the variable introduced by the indefinite subject, all variables that are subject to it have to be present or miss their chance. In other words, the existential closure operation is a one-time deal and could not be invoked

repeatedly within a single sentence. In (7a), for example, the indefinite subject 'yige nan tongxue' "a male student" introduces a variable; since this variable is lexically introduced, it has to be bound at the first stage and existential closure is thus called for. Once the existential closure is invoked, the e-variable has to be properly constrained for quantification. Since it is not in (7a), it violates HCEA and the sentence is not good.

It seems then, that taking this position on the conflict created between an indefinite subject and unconstrained e-argument renders our account of proper names, pronouns and definite NPs redundant: These NPs do not invoke existential closure at the first stage, therefore having an unconstrained e-variable is not a problem, since this variable has the opportunity to be bound off at the second stage. Postulating an EXIST predicate is therefore unnecessary. However, we can show that this is not true. For instance, when we have an indefinite NP in the object position, it should invoke existential closure just as well. This does not seem to cause any problem even if the e-variable is not constrained by any adverbial phrases, as long as the subject is either a proper name, a pronoun, or a definite NP, suggesting that in these cases, the e-variable is constrained by EXIST.

When the subjects are quantified NPs, then we have a different story. When it is a 'mei- n' phrase, the indefinite object is either skolemized, in which case no existential closure is called for and an unconstrained e-variable does not pose a problem; or the indefinite object NP is not needed for skolemization, in which case, it will invoke existential closure. However, this is not a problem for the e-argument:

The only condition under which the indefinite is not skolemized is when the e-variable is skolemized, and the e-variable can be skolemized only if it is lexically restricted by 'dou'.

When an indefinite NP is used both at the subject and the object position, an unconstrained e-variable creates problems. In this case, we either must have one of the lexical elements that can constrain the e-variable, such as the time, locative, or manner adverbs, or 'you', or such a sentence is ruled out by HCEA.

We conclude for this section that to place the existential closure operation outside a formula, thus allowing it wide scope with respect to quantifiers inside the formula as we have done in Chapter 2, is not incompatible with other facts in Chinese. The perceived difficulty of using indefinite/numeral phrases in the subject position in Chinese has been shown to be attributable to something else, namely, violation of HCEA by an unconstrained e-argument.

4.3.2. *Alethic Modals as e-argument Constrainters*

In addition to 'you', 'dou', and the spatiotemporal expressions, alethic modals can constrain the e-variable as well.

Lee (1986) considered two types of sentences with modals in his description of the distribution of numeral phrases, one is when the numeral NP receives universal quantification reading as illustrated in (21) (his original (249), p.87) and the other is when the numeral NP

retains its numerical reading, as illustrated in (22) (his original (247), p.87):

(21) *yige nanren **yinggai** yonggan.*

one-MW man ought-to brave

'A man ought to be brave.'

(22) *liangge ren **keneng** liqi bu gou.*

two-MW person perhaps strength not enough

'Two people may not have enough strength (for this task).'

There is reason for us to make a distinction between the two sentences, for the second one differs from the first one in that the word 'gou' "enough" can be viewed as a second order predicate. Second-order predicates are properties of properties. 'gou' in (22) is second-order because it does not predicate on entities, such as 'people' in (22), rather it is predicating on the cardinality of the set of people, which in this case is 'three'. (22) says that the cardinality 'three' of the set of people has the property of being enough for the contextually determined task. Second order predicates in general do not even need a modal to be predicated of a numerical subject NP. Take (23) and (24) for example:

(23) *liangliang che gou le.*

two-MW car enough LE

'Two cars are enough (for the task).'

(24) *sange ren xing.*

three-MW person fine

'Three people are fine (for the situation).'

There is existential quantification on properties in sentences with second order predicates such as the ones given here. We will use an example not involving numeral NPs to illustrate the point.

In Second-order logic, two different kinds of variables are used: x , y , z are individual variables and X , Y , Z are predicate variables. The following two examples and discussions are borrowed from Gamut (1991, Vol.1:168-169). The first one has a first-order predicate 'red' that is predicated of the entity 'Mars'; the second sentence has a second-order predicate 'color' that is predicated of the property 'red'.

(25) Mars is red

(26) Red is a color.

(27) Mars has a color.

Using both kinds of variables, we can represent the three sentences as follows:

(28) Rm

(29) $C R$

(30) $\exists X(C X \wedge X_m)$

From (30), (27) is interpreted as the proposition that Mars has the property of being red, which has the property of being a color; in (30) the variable X that is existentially quantified is a variable over properties. We have left out the e-argument in this discussion because we do not intend to get into the issue whether there is e-argument with second-order predicates. Because of the differences between first order and second order predicates, we will not consider (22).

Let us return to (21). (21) involves an alethic modal 'yinggai' "ought to, must", which is associated with universal quantification as Lee says. What does the modal itself do in this sentence then? In possible worlds semantics, an expression like 'ought to' might be modeled after the traditional modality in philosophy: 'it is necessary that'. The necessity operator, when applied to a formula, ϕ , means 'it is true in all accessible worlds that ϕ '¹⁰. But there is a problem. Even though 'ought to' and 'it is necessary that' would have a similar structure, the inference patterns might be different. For example, the inference that A from *necessarily A* is fine; but if what we have is *it ought to be that A*, then, it doesn't follow that A ¹¹.

Given this problem with modeling 'yinggai' and 'ought to' after the necessity operator, we would like to interpret the function of 'yinggai' as follows. When 'yinggai' is used, the sentence expresses a desirability; it does not express the notion that the sentence without the modal verb is a formula that is true in all accessible worlds; but rather it is true in

¹⁰ Accessible worlds are possible worlds that have a binary accessibility relation defined on them (L.T.F. Gamut, (1991), vol.2, 22-23)

¹¹ This is because the accessibility relation for necessity should be reflexive, but the relation for "ought to" should be irreflexive (Robin Clark, p.c.).

desirable worlds. The whole sentence containing 'yinggai' can be interpreted to mean that for every man there is a desirable world in which he is brave. If this interpretation about 'yinggai' is right, then we may say that 'yinggai' does two things in a sentence. It constrains the e-argument to the desirable worlds while the modal force associated with it introduces a universal quantifier into the formula. Given this interpretation of 'yinggai', not only do we have universal quantification within the sentence, which we will model after EVERY¹², there is also lexical restriction on the e-argument, hence skolemization of the e-argument can be performed. The logical translation of (21) would be (31).

(31) EVERY ({ x | (MAN(x)) { y | AT(BRAVE(y, f(x))) ∧ DESIRABLE-WORLD(f(x))})

Before we leave this section, let us return to Lee (1986), which has a chapter that systematically examines the distribution of numeral NPs in Chinese. Lee observed that "numeral phrases are generally prohibited from matrix subject position if no logical operators occur elsewhere in the sentence" (ibid. p.75). Nevertheless, there are exceptions to this generalization. After a very careful description of the distribution of the numeral phrases, Lee concluded that "While a numeral phrase can play a referential role in subject position when supported by a descriptive phrase, a topic or the universal quantifier 'dou', it can appear in that

¹² We do not claim, however, that all universal quantifiers in natural languages should be modeled after our skolemized definition of EVERY. Recall our discussion on the determiner 'all' in the previous chapter.

position non-referentially only in one context, viz. in the presence of a modal element (ibid. p.90)". What we have presented in this section, including observations from Fan (1986), Lee (1986), and S.-Z. Huang (1995a), is a uniform account for all the contexts in which numeral NPs can appear in the matrix subject positions in Chinese. Our generalization is that this apparent disparate cluster of contexts can actually be brought together into one coherent category because they all seem to play a role on the constraining of the e-argument. Time, locative and manner adverbial phrases of the ones examined provide a specific spatiotemporal dimension to the event; 'you' presents the event; alethic modal 'yinggai' "ought to" confines the event to be true in the desired world, and 'dou' restricts the reference of the e-argument to the minimum events compatible with the semantics of the predicate before it applies the sum operation on them.

In the next section, we will look at different types of e-argument constrainers in a more systematic fashion.

4.3.3. *Types of e-argument Constrainers*

Partially based on Jackendoff (1972) and Bellert (1977), Parsons (1990:62-64) classifies adverbial modifiers into five classes:

- I. Speech-Act Modifiers
- II. Sentence Modifiers

- III. Subject-Oriented Modifiers
- IV. VP Modifiers
- V. Other

Let us see whether and how these modifiers can function as constrainers on the e-variable.

According to Parsons, Speech-Act modifiers may be subcategorized as:

- Evaluative: 'fortunately', 'happily', 'surprisingly',...
- Epistemic Modal: 'perhaps', 'probably', 'certainly',...
- Conjunctive: 'therefore', 'however', 'finally', 'in conclusion',...
- Pragmatic: 'frankly', 'sincerely', 'honestly', 'in my opinion',...

Parsons describes these modifiers as making two assertions: "a main assertion of a fact that is determined by the rest of the sentence, excluding the modifier, and a secondary assertion stating that that fact has a certain property". Parsons gives (33) and (34) as the two assertions associated with (32):

- (32) Fortunately, Mary arrived on time.
- (33) Main assertion: Mary arrived on time.
- (34) Secondary assertion: The fact that Mary arrived on time is fortunate.

Parsons says that the dual assertion nature of the sentences with these modifiers "lets them display a kind of factivity" (ibid. p.62). Not surprisingly, this dual nature makes this type of modifiers natural candidates as constrainers on the e-variable. Take 'xingyun de shi' "fortunately" for an example:

- (35) ***xingyun de shi***, *yige mishu jide ba neifen*
 fortunate DE be, one-MW secretaryremember BA that-MW
zui zhongyao de wenjian dai dao huichang lai le.
 most important DE document bring come conference come LE
 'Fortunately, a secretary remembered to bring the most important document to the conference.'

(35) is predicted to be fine by HCEA even though the subject is an indefinite NP, because the e-variable is constrained by the modifier 'xingyun de shi' so that both the subject variable and the e-variable are bound off by the existential closure.

It is less straightforward, though, whether epistemic adverbs such as 'yexu' "perhaps" and 'keneng' "probably" can constrain the e-argument in the same way other members of this class of modifiers can. We find the following sentences with 'yexu' and 'keneng' not very good unless 'shi' "be" is also used:

- (36) ***yexu/keneng*** *(***shi***) *yige xiaohai zai dong libian.*
 perhaps/probably be one-MW child at cave inside
 'It is probably the case that a child is inside the cave.'

- (37) **yiding** *(**shi**) *yige xiaohai zai dong libian.*
must be one-MW child at cave inside
'It must be the case that a child is inside the cave.'

In fact, with 'shi', one does not even need the epistemic adverbs:

- (38) **shi** *yige xiaohai zai dong libian.*
be one-MW child at cave inside
'It is a child that is inside the cave.'

The emphatic 'shi' in (38) certainly makes the utterance a factive report on the situation, therefore we can take it to be the constrainer of the e-argument, in so much as it asserts the truth of the situation. Based on this data, we can certainly conjecture that 'shi' is turning adverbs like 'yexu' and 'keneng' from pure adverbs to epistemic modals, and as such 'yexu shi' and 'keneng shi' are legitimate constrainers of the e-variable.

The second class is Sentence Modifiers, which include the alethic modalities, such as 'possibly', and 'necessarily' (only their alethic readings are relevant here, not their epistemic readings). We have considered the modal word 'yinggai' "ought to", and have seen that it indeed can function as the constrainer on the e-argument. We can use 'keneng' "possibly" to illustrate the same point.

(39) *yige ren yisheng dangzhong **keneng** fan henduo*
 one-MW person one-life during possibly make many
cuowu.
 mistake

'It is possible that a person in his life time makes many mistakes.'

The third class is Subject-Oriented Modifiers, which include adverbs such as 'willingly', 'intentionally', 'deliberately', and certain readings of 'carefully', 'rudely', and 'wisely', etc. These modifiers are also described by Parsons as "factive". In Chinese, they can function as the e-argument constrainers too:

(40) *yige xiao nanhai **youyide** zai wo mianqian fang*
 one-MW little boy intentionally at I face-front ignite
le yigua bianpao.
 LE one-MW firecracker

'A little boy intentionally played a string of firecrackers in front of me.'

(41) *yige zhuchiren **hen congmingde** ba huati*
 one-MW emcee very cleverly BA topic
chakai le.
 digress-away LE

'An emcee very cleverly redirected the topic of conversation.'

The fourth class is composed of VP Modifiers, which include 'gently', 'quietly', 'smoothly', 'in the back', 'with a knife', and certain readings of 'carefully', 'wisely', 'rudely', etc. And again, this class of modifiers can constrain the e-argument.

- (42) *yige fuwuyuan **hen** **xiaoxinde** ba dishang de
 one-MW server very carefully BA floor DE
 sui boli pian shi le qi lai.
 broken glass piece pick LE up come*
 'A server very carefully picked up the pieces of broken glasses from the floor.'

- (43) *yige jianzhushi **yong** **huochai he** zuo le yige
 one-MW architect use match box make LE one-MW
 dalou moxing.
 building model*
 'An architect made a model of a large building with match boxes.'

The fifth class is labeled "Other Modifiers", which include words like 'merely', 'just', and 'only'. Although they have "various interesting functions in sentences", Parsons decides to ignore them (ibid. p.64). For our purpose here, we may note that all three words may be translated into Chinese as 'jiu' or 'zhi' as in (44):

- (44) *wo* ***jiu/zhi*** *xiang gen ta jian yimian, bing bu*
 I merely want with he see one-face, really not
xiang qiu ta shenme.
 want beg he what
 'I merely want to meet him, I have no intention of asking him for favors.'

and they seem to constrain the e-argument without any problem:

- (45) *yige xuesheng* ***jiu/zhi*** *wen le yige hen jiandande*
 one-MW student merely ask LE one-MW very simple
wenti, shei zhi ta turan boran danu.
 question who know he suddenly erupt-like big-rage
 'A student merely asked a fairly simple question but God knows why he flew into a rage.'

Parsons also observes that "Temporal Modifiers cut across the categories outlined above" (ibid.p.64). Typical examples include 'at midnight', 'from 2:00 to 3:00', which, as we have seen, are good candidates as e-argument constrainers. But Parsons also includes in the Temporal Modifier group locutions like 'usually', and 'never', which we find to be unable to constrain the e-argument as shown in (46) below:

- (46) **yige laoshi* ***tongchang*** *fudao zheixie xuesheng.*
 one-MW teacher usually tutor these student

'A teacher usually tutors these students.'

- (47) **yige* *nongmin* ***conglai*** *mei kan guo dianying*¹³.
one-MW peasant always not see GUO movie
'A peasant has never seen a movie.'

However, this is not surprising, given that these frequency adverbials can be treated as quantifiers in a logical form (Lewis, 1975). As quantifiers, they of course cannot act as constrainers on the e-argument at the same time.

4.3.4. *Postverbal Phrases*

Now we have a systematic description of what adverbial modifiers can be e-argument constrainers (categorically speaking, all five classes have at least some members that can). One remaining issue that we would like to consider next is that some of the phrases that can constrain the e-argument when used preverbally cannot function as e-argument constrainers when appearing in the post verbal positions. The following sentences involve phrases like 'fei kuai' "fast like flying", while (48a) is good, (48b) is not:

- (48) a. *yige* *shibing* ***feikuaide*** *pao le guo lai*.
one-MW soldier fly fast run LE passcome

¹³ GUO is the so-called 'experiencer' marker, so V-GUO means "to have the experience of V-ing".

'A soldier dashed over to us.'

b. **yige shibing pao de fei kuai.*

one-MW soldier run DE fly fast

'A soldier runs extremely fast.'

The explanation of this contrast can be found in C.-T. Huang (1988) in which the postverbal phrase like 'fei kuai' is treated as a secondary predicate while the verb 'pao' "run" constitutes the primary predicate. As a secondary predicate, the postverbal phrase 'fei kuai' has lost its role as an adverbial modifier and hence it cannot act as a constrainer on the e-argument.

4.3.5. Differences and Conflicts among the e-argument

Constrainers

What is left unexplored in the previous sections is the differences and conflicts among the e-argument constrainers. For instance, 'you' and 'dou' cannot function as e-argument constrainers simultaneously as we have seen earlier, although alethic modal 'yinggai' "ought to" does not run into conflict with 'dou'. The following examples illustrate this point:

(49) *meiyige xuesheng dou yinggai hui shuo*
every-ME student dou should know-how speak

liangmen waiyu.

two-MW foreign language

'Every student should be able to speak two foreign languages.'

One may conjecture that 'you' and 'dou' make different semantic contributions to the sentences and their contributions are incompatible. 'You' presents the event into the discourse, which is related to the existential and presentational nature of 'you'-sentences. 'Dou', in contrast, is a sum operator that unions the minimum events into a plural event, and these minimum events have to be presupposed rather than presented when 'dou' is used.

We would also like to make an observation that the same five classes of modifiers presented in the previous section that can constrain the e-argument for existential quantification of the e-variable do not seem to be sufficient for universal quantification (not sufficient for skolemization of the e-variable). This is evidenced by the following sentences:

- (50) a. **?meiyige xuesheng **zuotian** ting le diwuke*
every-MW student yesterday listen LE lesson five
luyin.
recording
'Every student listened to Lesson Five's recording
yesterday.'

- b. *?meiyige xiaotou **xianzai zheng zai ner** shu
 every-ME thief now right at there count
qian.
 money.
 'Every thief is counting money right now.'
- c. *?meiyige ren **jiang** dedao tisheng.
 every-MW person will have promotion
 'Every person will have a promotion.'
- (51) a. *?meiyige chengke **xunsude** zhengli hao le xingli.
 every-ME passenger swiftly tidy well LE luggage
 'Every passenger swiftly set (their) luggage in order.'
- b. *?meiyige gongren **henkuaide** zuo wan le zuihoude
 every-ME worker quickly do finish LE last
gongzuo.
 work
 'Every worker quickly finished the last piece of work.'
- c. *?meiyige bingren **manmande** chiwan le yao.
 every-ME patient slowly eatfinish LE medicine
 'Every patient slowly finished taking the medicine.'

Sentences in (50) all contain a temporal phrase and the ones in (51) all

contain a manner phrase. These adverbial phrases have been shown to constrain the e-argument so that the e-argument can be present for existential binding. If it were just a matter of lexically introducing the e-argument into the first stage of interpretation, then it would have been surprising that the same phrases that seem to perform a function in one context fail to perform the same function in another. However, we would like to point out that what is at issue here is more than just lexical constraining.

It has been generally accepted that in addition to classifying lexical items into main categories, there is also need to put subcategorization and selectional restrictions on them, otherwise semantic incompatibility will be rampant in the phrase structures, such as "Caesar is a prime number" (Gamut, 1991, Vol.I:19) or "The argument wants to be convincing" (Riemsdijk and Williams (1986:131). What we have witnessed here, we believe, are also some kind of selectional restrictions or "sortal correctness" the quantifiers put on their arguments. The adverbial modifiers can constrain the e-argument mainly because they are "factive" in Parsons' term. By being "factive", they provide specifics of an event so that the e-argument loses its kind reading and can be existentially quantified for a specific reading.

However, in the context of a universal quantifier subject such as 'mei- n', the e-argument is often needed for skolemization, and given that the skolem function is to create a list of pairs between each member of the first argument with the members of the second argument of EVERY, minimum events are sought after, which the sum operator 'dou' can help

provide by minimizing the event to the minimum size appropriate to the predicate (recall the case of 'dou-MEET' discussed in Chapter 2) before these minimum events are summed up. This is a function the five classes of adverbial modifiers cannot perform, hence their usage will not help skolemization.

This consideration also helps us make a useful distinction between tense and the spatiotemporal adverbial modifiers. Tense induces a partial order on T , T being a set of points or periods of time, and tense as we defined in Chapters 2 and 3 is an operator that maps events onto times; this operation will result in the size of events being minimizable if every event corresponds to a point or period of time. This is perhaps why tense is perceived to perform a far wider range of functions than 'dou' or any other adverbial constrainers: It is sufficient to constrain the e-argument in both existential and universal quantification contexts, whereas the adverbial modifiers that Chinese has to use can only assist existential quantification and 'dou' for universal quantification.

This notion of selectional restriction for quantification in natural language can be far reaching in both Chinese and English. In Chapter 2, we have seen that 'each' has some preferences that 'every' does not have. For example, 'each' prefers to have indefinite NPs in its scope in order for the sentence to sound natural (Kroch, 1974), but 'every' does not seem to have this preference. Furthermore, in logic and natural language semantics books, sentences with a definite subject and past tense are usually the examples for existential quantification of the e-argument; generic sentences usually involve present tense. Many of the issues

pertaining to this topic are scattered in works in tense logic and aktionsarten (Binnick (1991). A more detailed investigation of English and Chinese in this regard is beyond the scope of this dissertation.

4.3.6. Paired but Split Expressions in Chinese

We have gone into some considerable length into presenting evidence supporting the validity of HCEA and its role in assuring the success of quantification of events. The main goal, of course, is to show that our postulation that 'dou' is a constrainer on the e-argument so that the e-argument can be skolemized for EVERY is more than just an ad hoc stipulation, but part of a prevalent pattern in Chinese.

To give further support to our last statement we would like to point out that there are many Chinese expressions that seem to be paired but split. Since they have not been presented systematically, we would like to give them the exposure they deserve, not to mention that their existence has significant bearings on our analysis of 'dou'.

In the list below, we may take all the pairs as two-place operators with each member of the pair taking an argument. Given that all their arguments have a clausal status, one may conclude that it is the event variable they operate on. What is most important about these expressions is that the verb particles (the second member of the pair) constitute an obligatory part of the expressions, with extremely rare exceptions.

(52) Paired but Split Expressions in Chinese

<i>yinwei</i> A <i>suoyi</i> B	'because A therefore B'
<i>suiran</i> A <i>danshi</i> B	'although A, B'
<i>budan</i> A <i>erqie</i> B	'not only A but also B'
<i>yaoshi</i> A <i>jiu</i> B	'if A, then B'
<i>ruguo</i> A <i>jiu</i> B	'if A, then B'
<i>yi</i> A <i>jiu</i> B	'as soon as A, B'
<i>zhiyao</i> A <i>jiu</i> B	'as long as A, B'
<i>jiran</i> A <i>jiu</i> B	'since A, B'
<i>bushi</i> A <i>jiushi</i> B	'if not A then B'
<i>zhiyou</i> A <i>cai</i> B	'only A B'; 'only if A, B'
<i>lian</i> A <i>dou/ye</i> B	'even A B'
<i>shenzhi</i> A <i>dou/ye/hai</i> B	'even A B'
<i>jishi</i> A <i>dou/ye/hai</i> B	'even if A B'
<i>meiyige</i> A <i>dou</i> B	'every/all A B'
<i>wulun</i> A <i>dou/ye/hai</i> B	'no matter A B'
<i>buguan</i> A <i>dou/ye/hai</i> B	'no matter A B'
<i>renping</i> A <i>dou/ye/hai</i> B	'no matter A B'

The relevance of this list to our analysis of 'dou' is that indeed 'dou' is not an unusual phenomenon in Chinese; it is a manifestation of a common strategy in the language to lexically constrain the e-argument so that quantification involving the e-argument can satisfy HCEA. Perhaps

this general phenomenon of a large number of paired but split phrases originates from the parametric characteristic of Chinese as well, that is, absence of tense. If we treat tense as the ultimate correlative link between the arguments and the predicates, or the subordinates with the matrices, then absence of tense requires that overt verb particles be used to mark such relations. More concretely, the obligatory use of tense in the matrix clause in English assures that the e-argument is always constrained appropriately and quantification involving this variable is not problematic. Without tense, Chinese resorts to overt use of verb particles of which the above list presents a sample. This is still very vague, but this parametric perspective on a whole host of sentence structures in Chinese does seem to be the right one to take, although this task cannot be carried out here.

4.4. Constraining and Universal Quantification of the E-argument in Conditional Sentences

The previous sections in this chapter have been mainly devoted to presentation and discussion of evidence supporting the proposed HCEA, especially in the context of existential quantification of the e-argument. In what follows, we further support our HCEA and skolemized definition of EVERY by examining a number of conditional sentences. The main arguments to be advanced in this section are that (a), in addition to 'dou', other verb particles may be used for constraining the e-argument in the

context of universal quantification, and (b), universal quantification manifested in conditional sentences can be modeled after our skolemized definition of EVERY in ways that may help account for some co-occurring phenomena such as the optionality or obligatoriness of the verb particle 'jiu'.

In the recent literature, it has been generally accepted that 'if' conditional sentences involve adverbial quantification (Lewis, 1975). For example, Kratzer (1986) argues that what the antecedent (the 'if' clause) does is to provide a restrictive clause for the adverbial quantifier. For example, in the sentence below, 'if' does not make any lexical contribution to the sentence, except to introduce the restrictive clause for 'always':

- (53) a. If Joe gets a raise, then Jerry gets upset.
b. Always e (e involves Joe gets a raise) (e involves Jerry gets upset)

One can say the same thing in a parallel structure in Chinese:

- (54) *yaoshi Zhangsan zhangle ji, Lisi jiu hui shengqi.*
if Zhangsan raise LErank, Lisi jiu wouldget-angry
'If Zhangsan gets a raise, Lisi will get mad.'

Whether one adopts Kratzer's tripartite representation of universal quantification for the 'if' conditionals, it is clear that it is the event argument that is being quantified. Since we have said that the e-argument in Chinese has to be restricted by a lexical item in order for it to be available for any operation at the first stage of interpretation, we need to have an account on how the e-argument becomes available for the universal quantification. The natural candidate we would like to consider is the irrealis operator 'ruguo' "if"¹⁴. What 'ruguo' does in the antecedent clause is similar to what 'you' does in that they in their own ways introduce the e-argument into the discourse. 'you' presents the existence of the event; 'yaoshi' hypothesizes it. In turn, we can say that 'you' restricts the e-argument to the presented events and 'yaoshi' restricts the e-argument to the hypothesized events.

It is worth noting that in the tripartite account of conditionals, only the e-argument from the antecedent clause participates in the universal quantification, the e-argument from the consequent clause does not. Our intuition is that a conditional sentence may very well be interpreted as saying something like: For every event *x*, there is an event *y* to be paired with it, which, as we can see, is the prototypical paired readings we have argued for the semantics of 'every' and 'mei'. It is actually fruitful to have a parallel between the two clauses in terms of treating the two clauses as each contributing an e-argument for quantification. In fact, we can model

¹⁴ Our analysis of 'ruguo' is expected to extend to its synonyms such as 'yaoshi', 'jiaru', etc.

the adverbial universal quantification after our EVERY. But in order to do that, we need to give a description of the syntactic relation between the two clauses.

We take as part of the meaning of the 'ruguo' conditional a 'result in' relation between the first event and the second event. Thus, we postulate that the antecedent clause and the consequent clause are linked by an abstract predicate 'RESULT-IN', so that we can capture the meaning of this type of conditional sentences as 'every event x results in the event y'. In terms of our definition of EVERY, (54) says that the set of events in which Zhangsan gets a raise is a subset of the set of all events that result in the events in which Lisi gets upset (there can be other events that result in Lisi getting upset). It is the e-argument associated with the consequent clause that gets skolemized, which means that from every value assignment of event x, a value for event y is assigned, through that assignment, the second argument of EVERY gets constructed.

There is one more issue to be resolved before we can really proceed, and that is the restriction of the e-argument associated with the consequent clause. If 'ruguo' restricts the e-argument from the first clause, what restricts the one from the second clause? The answer is quite simple: It is restricted by the adverb 'jiu'. 'Jiu' is usually translated into English as "then", or "consequently". It may be used in non-conditional sentences with those meanings as well. But in a conditional sentence, the presence of 'jiu' is obligatory. We may attribute this obligatoriness to its responsibility for restricting the

e-argument ¹⁵. If we formally represent 'ruguo' as restricting the antecedent e-argument to HYPOTHESIZED events, then we may formally represent 'jiu' as restricting the relevant e-argument to CONSEQUENT events. Once so restricted, skolemization on the e-argument in the consequent clause can take place.

The following is the formal representation of this interpretation of the conditional sentence (54) under our skolemized definition of EVERY:

(55) EVERY({ x | AT(GET-A-RAISE (Zhangsan, x) ∧ HYPOTHESIZED (x))}, {y | RESULT-IN (y, AT(GET-UPSET (Lisi, f(x)) ∧ CONSEQUENT (f(x))))})¹⁶

Our analysis of the conditional sentences exemplified by (54) can be extended to the so-called "bare" conditionals that Cheng & C.-T. J. Huang (1996) discussed. C&H made a study of the bare conditionals with the issue of 'donkey' phenomena in mind. They argue that there are two types of 'donkey' sentences, and therefore there is need to keep the Heim/Kamp (1982, 1981, respectively) account in terms of unselective binding, in addition to the more traditional E-type pronoun strategy

¹⁵ For two earlier studies of 'jiu', see Biq (1984) and Paris (1985). For a full formal semantic account of 'jiu', see Lai (1995). Lai in fact calls 'jiu' a scalar particle in which the expected event and the real event stands in a partial order relation with respect to time. We believe that this property of 'jiu' qualifies it to be a constrainer of the E-variable in the consequent clause. 'Dou', on the other hand, is the constrainer of the E-variable in the consequent clause in the 'wulun' "no matter" type of sentence; in the 'ruguo' "if" conditionals, with an explicit or implicit 'ruguo', 'jiu' is the constrainer of the E-variable in the consequent clause. Note that in Cheng and Huang (1996), 'dou' is treated as the source of universal quantification in the 'wulun' type of conditionals, whether 'wulun' is explicit or not. We believe that in such a treatment of 'dou', the parallel between 'dou' and 'jiu' is lost.

¹⁶ We claim that non-lexical predicates do not come with an AT function. Since there is no AT with RESULT-IN, there is no extra E-argument either.

(Evans (1980)). So (56) should be represented as (57), which is an unselective binding account of (56).

(56) If a farmer owns a donkey, he beats it.

(57) $\text{ALL}_{x,y}, (\text{farmer}(x) \wedge \text{donkey}(y) \wedge x \text{ owns } y) (x \text{ beats } y)$

They used the "bare" conditionals in Chinese to show that the 'donkey' type of anaphoric pronouns¹⁷ in the consequent clause cannot be treated as E-type pronouns, as claimed in Evans (1980), where E-type pronouns are definite descriptions. The following is an example of bare conditionals which contains two wh-phrases, one in each clause. In C&H's treatment, wh-phrases are indefinites that introduce variables, following Cheng (1991) and Y.-H. A. Li (1992).

(58) a. *shei xian lai, shei (jiu) xian chi.*

who first come, who (jiu) first eat

'Whoever comes first eats first.'

b. $\forall x (x \text{ comes first} \rightarrow x \text{ eats first})$

They argue that the second wh-phrase corresponds to the "donkey" pronoun in (56), and it should be treated as an indefinite NP, not a definite description, because it cannot be replaced by pronominals and demonstratives, as illustrated in the sentence below:

¹⁷ A "donkey" pronoun is a bound pronoun whose antecedent is in a different clause.

(59) *shei xian lai, shei/*na-ge-ren/*ta/*pro jiu yao*
 who first come, who/that-MW person/he/pro jiu have to
qing-ke.
 invite-guest
 'Whoever comes first will have to treat (us).'

We agree with C&H for taking the second wh-phrase as an indefinite phrase, not a definite description. And we would like to model the universal quantification present in this type of sentences after our skolemized definition of EVERY just as we have done with the 'ruguo' conditionals.

In the bare conditionals, we can argue that the two occurrences of wh-phrases, one in each clause, provide the necessary variables for EVERY. Recall that the skolem function EVERY is associated with two variables by making the choice of a value for one variable depend on the choice of a value for the other. So, from the first variable the first argument of EVERY will be constructed, and the skolem function will take the second variable as its argument so that from each value assignment in the first set, a value assignment is determined for the second variable, so that each member in the first set is paired with a member in the second set, which, of course, is the most salient reading of such donkey sentences.

In order to capture the fact that the two indefinite wh-phrases in the two clauses are always identical, C&H propose a constraint (their Revised Parallelism Constraint on Operator Binding, *ibid.* p.139) that

basically says that for every variable in the restrictive clause, there must be an identical variable in the nuclear scope. This constraint can be matched by a stipulation in our account that the appropriate skolem function in bare conditional sentences is the identity function. Recall that, as we have seen in Chapter 2, the skolem function can be equated with the identity function as in sentences with a reflexive object, such as 'Every man shaved himself'. The result that the two sets are identical is not a problem as far as our formal definition of EVERY is concerned in terms of the subset-superset relation between the first set and the second set of EVERY: A set is always a subset of itself.

The main difference between bare conditionals and sentences involving 'mei- n' is that with a 'mei- n' phrase, with x being the variable for the first set, and y for the second set, it is the variable z contained within the predicate that is used for skolemization and the value for y is constructed via the value assignment of z via the value assignment of x . In the case of bare conditionals, y can be directly skolemized and due to the nature of the identify function, the set denoted by x and that by y are identical. The configurations as given below should show the difference, with (a) for 'mei- n' sentences and (b) for bare conditionals (i.e.: wh-phrase...wh-phrase...)

- (60) a. EVERY $\{x \mid \text{PRED}(x)\}, \{y \mid \text{PRED}(y, f(x))\}$
 b. EVERY $\{x \mid \text{PRED}_i(x)\}, \{f(x) \mid \text{PRED}_j(f(x))\}$

The following is the formal representation of (57):

(61) EVERY({ x | PERSON(x) \wedge AT(COME-FIRST(x),e)},{ f(x) | PERSON(f(x))
 \wedge AT (EAT-FIRST (f(x), e))

A question arises as to why *y* is not available for skolemization in a 'mei- n' sentence. Because if *y* is available for skolemization, then there is no need for the *e*-variable, hence no need for 'dou'. The answer again is tied in with the condition that only variables lexically or morphologically introduced into the logical translation can be skolemized. In a sentence with a 'mei- n' subject, *y* would be corresponding to the trace of the subject, which allows the VP to be an open formula; since this empty position is neither morphologically nor lexically introduced, it is "structurally" introduced, so to speak, it cannot be skolemized.

Of course, it does not have to be *wh*-phrases in the two clauses in the bare conditionals that provide the necessary variables for skolemized universal quantification. We have shown that event variables in the two clauses will do, too. Another natural candidate is indefinite NPs in the two clauses, as illustrated below:

(62) *ta bing yichang, ta mama (jiu) bing yichang*¹⁸.
 he sick one-session, he mother jiu sick one-session
 'Every time he gets sick, his mother gets sick.'

¹⁸ C.-T. J. Huang used (i) during a question/answer period at NACCL-5 held at the University of Delaware, May 14-16, 1993 that inspired us to consider (62):

(i) *lai yige, da yige; lai liangge, da yishuang*.
 come one-MW, hit one-MW; come two-MW, hit a-pair
 'If one target shows up, (we'll) hit one target; if two targets show up, (we'll) hit both of them'

(62) literally means every event in which he gets sick is matched by an event in which his mother gets sick. This is the perfect paired reading in universal quantification and what gives rise to this pairing is the pairing out of the two indefinite NPs, one in each clause.

It seems that modeling the universal quantification in bare conditionals like (54) and (62) after EVERY has an advantage in that it predicts that 'jiu' in these sentences is optional as C&H have observed: Since the second clause contains either an indefinite wh-phrase or an indefinite NP, the e-argument is not needed for skolemization and as a result, the service of 'jiu' as a lexical constrainer of the e-argument is not required, thus it is optional.

By the same token, our account can predict when 'jiu' is obligatory. We have seen that in (54), 'jiu' is obligatory; C&H noticed that in the following sentences 'jiu' is also obligatory:

(63) *shei yonggong, neige ren *(jiu) shangdeliao*
who hard-working, that-MW person jiu can-attend
daxue.

college

'If someone works hard, that person can get admitted to a college.'

This is an example of an implicit 'ruguo' conditional, which they consider as demonstrating the E-type pronoun (as shown by the definite NP in the second clause). The obligatoriness of 'jiu' in these two

sentences is accounted for by our analysis: In both (54) and (63), there is no other variable available in the consequent clause, e-argument becomes crucial for skolemization and 'jiu' is required to lexically introduce it.

A related type of sentences provides further support to our analysis of (54) in terms of constraining the e-argument. Let us consider (64).

(64) *Lisi yi shangke jiu shuijiao.*

Lisi one attend-class jiu sleep

'As soon as Lisi goes to class, he dozes off.'

Or

'Every time Lisi goes to class, he dozes off.'

(64) has the same kind of reading as (54), namely, as far as Lisi is concerned, for every event of him going to class, there is an event of him sleeping. This is the paired reading of the two events, and of course the causal relation can be captured by the abstract predicate 'RESULT-IN'.

What makes (64) interesting is that although it has a conditional reading, there is no 'ruguo' or its synonyms in the sentence, nor can there be one used overtly, suggesting that there is no covert 'ruguo' operator in this sentence (see Cheng & C.-T. Huang (1996) for the argument that sentences like (63) contain an abstract 'ruguo' operator).

The question that concerns us is: If the overt 'ruguo' or its synonyms restrict the e-argument of the antecedent clause to meet HCEA, what takes over that function in (64) for event quantification? The answer is, it is 'yi' "one". 'yi' is the lexical item that corresponds to both 'a' and 'one' in English. It makes a noun phrase indefinite so that the NP containing 'yi' (and a measure word) introduces a variable into the logical translation as we have seen in the previous examples such as 'yige ren' "a-MW person", 'yishou shi' "a-MW poem", etc.

We can take 'yi' in (64) simply as an extension of this function to verbs in terms of providing lexical restriction. With 'yi', the e-argument in the antecedent clause is made present for quantification.

The last type of conditional sentence we would like to consider is given below:

(65) *ta mei xie wan yipian wenzhang wo dou qing ta*
 he every write finish one-MW article I dou treat he
da-chi-yi-dun.

big-eat-one-meal

'For every event in which he finishes writing an article, there is an event in which I treat him to a hearty meal.'

'Mei' in the first clause is the morpheme in *meiyige* "every-one-MW". Here 'mei' is in a preverbal position. Just as the noun phrase with the determiner 'mei' is a combination of 'mei' with an indefinite noun, 'mei-

VP' also requires that there be an indefinite within the VP. Indefinite noun phrases, indefinite adverbial phrases, or other variable introducing elements such as 'ci' "time" (as in 'She won the award three times'; this word does not need a measure word because it is a quasi-measure word itself as described in traditional grammar) can all serve this purpose. When the VP contains no such variables, the sentence with 'mei' as a preverbal determiner is unacceptable. In the search for variables within VP, the e-argument does not seem to automatically qualify, again proving HCEA to be correct. The following sentences illustrate this point:

(66) *wo mei kan *(yici) zheishou Tang shi, dou you*
 I every read once this-MW Tang poem, dou have
yixiexinde tihui.
 some new interpretation
 'Every time I read this Tang Dynasty poem, I have some new
 interpretations.'

(67) *ta mei bing *(yichang), ta mama dou yao bing*
 he every sick one-session, he mother dou will sick
yichang.
 one-session
 'Every time he gets sick, his mother will get sick.'

(68) *Zhangsan mei da Lisi *(yixia), Lisi dou yao da jiao*
 Zhangsan every hit Lisi one-stroke, Lisi dou will loud cry
yisheng.
 one-sound
 'For every strike Zhangsan landed on Lisi, Lisi would give out a
 loud cry.'

(69) *Lisi mei ku *(yisheng), Zhangsan dou yao ma ta*
 Lisi every cry one-sound, Zhangsan dou will scold he
yidun.
 one-session
 'For every crying sound Lisi makes, Zhangsan will give him a
 scolding lesson.'

(70) *Lao Wang mei pao *(yibu) dou yao shichu hendade*
 Lao Wang every run one-step dou will take very-big
liqi.
 strength
 'For every step he runs Lao Wang has to make a great effort.'

(66)-(70) show that with the indefinite adverbial phrases as modifiers on the verb, the use of 'mei' as a VP determiner is unproblematic, otherwise the sentences are all ruled out. The same is true in (65) where if the object NP is definite, the sentence is not acceptable either.

(65) - (70) together show once again that the event variable is not automatically available for quantification in Chinese. There are two ways to interpret the requirement for all those adverbial phrases that make the VP quantifiable by 'mei'. One is that these are independent variable introducing elements so that 'mei' can be used to quantify over domains restricted by them. The alternative interpretation is that their function is to help the entire VP to carry a variable so that the preverbal 'mei' can take this variable as its first argument.

The first alternative says the indefinite adverbial phrases introduce variables which range over entities (i.e., 'yipian wenzhang' "an article" introduces a variable that ranges over articles). The second alternative says the indefinites help the VP to introduce the event variable that, by definition, ranges over events. We choose the second interpretation over the first one because there is evidence that the first interpretation is problematic and there is some clear indication that the preverbal 'mei' quantifies over events.

If the first alternative were right, one would expect that 'mei' could appear as the determiner of 'yipian wenzhang' "an article" directly in such type of sentences. However, as we can see in (71), it is not true¹⁹:

¹⁹ We do not rule out the possibility that 'mei' is originally an NP determiner in the object phrase that gets adjoined to VP so that it can take the main clause as its second argument. However, we will not pursue this possibility further.

(71) **ta xie wan meiyipian wenzhang wo dou qing ta*
 he write finish every-one-MW article I dou treat he
da-chi-yi-dun.
 big-eat-one-meal
 *'He finishes writing every article, I treat him to a hearty meal.'

Nor would a preverbal 'mei' do if no consequent clause is part of the sentence as shown by (72). (72) has a distinct flavor of an unfinished sentence:

(72) **ta mei xie wan yipian wenzhang.*
 he every write finish one-MW article

(72) shows that the clause with a preverbal 'mei' has to be linked with another clause. This fact could be explained if 'mei' is taken to be relating two sets of events, expressed by two clauses, not just relating a set denoted by a constituent with a set denoted by the rest of the same clause, as is the case with 'mei- n' phrases.

Another reason the preverbal 'mei' should be viewed as relating two sets of events is the requirement on its relative height in the hierarchical representation of the sentence. It has to be in a position high enough in order for it to take two clauses to be its arguments (in other words, to c-command the two e-variables which are its two arguments). The same thing might be said about 'every' as we can see in the following English sentence:

(73) *He finishes writing each article, I treat him to a hearty meal.

One has to say

(74) For each article he finishes writing, I treat him to a hearty meal²⁰.

Note that (74) is not exactly the structural parallel of (65) although it might serve as a natural sounding translation of the latter. In (74), 'every' is quantifying over 'article' which is restricted by the relative clause 'he finishes writing'. In (65), we have a clause, not a complex noun phrase, of which 'mei' is a part. NPs in Chinese are head final; a complex NP in Chinese is formed by the relative clause appearing before the head noun in a configuration as illustrated in (75), which is the Chinese translation of (74).

(75) *wei ta xie wan de meiyipian wenzhang, wo dou qing*
for he write finish DE every-MW article, I dou treat
ta da chile yidun.
he big eatLE one-meal

²⁰ Of course one can also say

(i) I treat him to a hearty meal for every article he finishes writing.

This is because the 'for' clause has an adjunction site high enough in the clause to have the event variable within its c-command domain.

This requirement on the relative height of 'mei' can again be traced back to our formal definition of EVERY. By this definition, EVERY is always associated with a skolem function and this skolem function has to be c-commanded by EVERY. When the two arguments of 'mei' come from two separate clauses, 'mei' has to be in a high enough position so that the skolem function that applies to the event variable of the second clause can be in the c-command domain of 'mei'.

Furthermore, even though one might consider the possibility that 'mei' quantifies over 'articles' in (65), in the other members of that group of sentences, it is hard to determine what 'mei' quantifies over. Take (68) for example. In (68), the indefinite phrase 'yixia' "one stroke", is a measure phrase on the verb, describing the action portrayed by the verb, and can be assimilated to measure words on nouns in Chinese (Tang, 1990). The same thing can be said about 'yici' "once", 'yisheng' "one sound", 'yibu' "one step", and 'yichang' "one session".

In order to understand what semantic contribution the adverbial measure phrases make to a verb phrase, let us consider what adjectival measure phrases contribute to a noun phrase, for there is some parallel that can be drawn between the two types of phrases, although the parallel is incomplete as we will see below.

Chierchia (1996) argued that Chinese nouns denote plural entities, they are thus not predicative. In other words, Chinese nouns are of type e , denoting entities, not $\langle e,t \rangle$, which are functions that map entities into truth values. Measure words in Chinese have the function of turning

nouns into predicates. We may use the following schema to illustrate Chierchia's point:

- (76) a. shu: 'tree', e
b. -ke_{MW} shu: 'KE tree', <e,t>, TREE
c. yike_{MW} shu: 'a KE tree', 'a tree', TREE (x)

If indefinite adverbial phrases such as 'yixia' "one stroke" are to verbs what measure words are to nouns, we may infer that adverbial measure phrases turn verbs into variable carrying predicates. However, if adverbial measure phrases for verbs were assimilated completely to measure words for nouns, one may be forced into a position to argue that in those sentences in which there is no adverbial measure phrase the VP does not carry an event argument, which would lead to the ultimate claim that such VPs are not predicative. This is not an appealing account of VPs since many good sentences in Chinese do not have adverbial measure phrases. Given this consideration, we will make a distinction between the adjectival measure phrases such as 'yige' "a-piece" and adverbial measure phrases such as 'yixia' "a-stroke". The former, as Chierchia claims, turns an entity denoting noun into a predicate that carries a variable while the latter lexically constrains the e-argument the verb already carries.

The conclusion from this discussion on the group of sentences is that the preverbal 'mei' in (65)-(70) is best interpreted as taking the two

clauses as its two arguments, and in the antecedent clauses, the indefinite adverbial phrases are all constrainers of the event variable.

Again, using the abstract predicate 'RESULT-IN', we can interpret the meaning of, say, (68) to be that the set of events in which Zhangsan hits Lisi a stroke is a subset of the set of events that result in the events of Lisi cries out in loud voice. Under this analysis of the two clauses in (68), the formal representation can be given in (77), which uses the English glosses for ease of presentation.

(77) EVERY ({ x | AT(HIT(Zhangsan, Lisi, x) \wedge STROKE(x)),
 { y | RESULT-IN (y, AT(LOUD CRY(Lisi, f(x) \wedge SOUND(f(x)))
 \wedge DOU (f(x), LOUD CRY))}

x stands for the e-argument from the antecedent clause and f is the appropriate skolem function; f(x) replaces the e-argument from the consequent clause. We can have the second event variable for skolemization because it is lexically constrained by 'dou' in the consequent clause.

4.5. A Remaining Issue

It is argued in this chapter that the e(vent)-variable is not available for any operation unless it is lexically constrained. We have tested our

HCEA against a relatively wide range of cases each of which has supported our hypothesis.

However, HCEA is based on the premise that this is so only at the first stage of interpretation. When nothing hinges on the variable, it can be existentially bound off by the existential closure at the second stage of interpretation. The weakness in this premise is that we have not said much about how exactly this two-staged interpretation works in our system, except for using some empirical arguments (e.g. the argument structure of 'eat') for its necessity. But the empirical argument has its own weight and any theory on quantification will have to account for it.

At this point we are only prepared to say that the intuition behind the two-staged interpretation is that the existential closure, which comes free at any rate, is a default mechanism to make sure that there are no unbound variables left in the formal representation of a sentence, unless, of course, it is invoked by a lexically or morphologically introduced variable, such as an indefinite NP, in which case, every variable that needs its existential quantification force has to be present or loses the chance at the first stage. Universal quantification, on the other hand, is not a default operation, at least to our intuition, and thus always requires lexically or morphologically constrained variables. We will leave the issue open as to how to provide a more rigorously articulated theory to account for the difference between existential and universal quantification of event arguments.

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