WRITING SAMPLE (1)

To whom it may concern,

This is Hezao Ke, an applicant for your PhD program in Linguistics (birth date: 07/30/1987). I learned that you need one writing sample, and I would like to upload a summary of my MA thesis as the writing sample. Writing sample (1) is the summary.

In addition, I think that my paper prepared for GLOW in Asia IX is also helpful for you to know my experimental study better. So I include it as an additional writing sample for your reference, i.e. writing sample (2).

Your time and consideration would be greatly appreciated.

Best regards,

Hezao Ke

RESTRICTORS OF THE DISTRIBUTIVE OPERATOR "DOU" IN ADULT AND CHILD MANDARIN

Master's Thesis Summary

Hezao Ke

Introduction

The basic assumption of this thesis is that the core distributive computation associated with the distributive operator *dou* (roughly corresponding to *all* in English) is simple, but in some cases the distributive computation may be complicated by related procedures such as restrictor selection. Theoretical and experimental studies are conducted to verify this assumption.

Two levels of distributivity, distributivity at the level of atoms/sums of atoms and the level of sub-atoms, are explored in order to capture distributive computation over various restrictors, including plural NPs, mass NPs (which contain temporal and spatial NPs), wh-phrases, as well as quantified phrases such as *Mei*-phrases and *Zheng*-phrases.

Theoretical study draws a prediction that children are possibly competent with simple distributive computation introduced by *dou*, but would give different interpretations than adults when the selection of restrictors are complicated, for instance, when there are two potential candidates available for the restrictor *dou*. Three experiments were designed to investigate how children and adults interpret *dou*-distributions with two potential candidates for the restrictors.

The first experiment investigated how children choose a proper NP as the restrictor when there are two plural NPs to the left side of *dou*. The results revealed that children were unable to determine which NP is more appropriate for the restrictor, while adults were inclined to take the NP closer to *dou* as the restrictor. In the second experiment we separated the two NPs into two sides of *dou*, and we found that children were flexible to take the right side NPs as the restrictors, while adults were not. The third experiment found that children were flexible to take either the NP to *dou*'s left or the wh-phrase to *dou*'s right as the restrictor. The results are similar with those of the first experiment. Adults, however, tended to derive a new interpretation resulting from assigning the wh-phrases wide scope comparing to *dou*-NPs. Therefore, the three experiments verified our assumption that distributive computation induced by *dou* are essentially simple, and it becomes difficult to children when *dou*'s restrictors are complicated.

Theoretical analysis of dou-distributive computation

In this study, we attempt to provide a unified analysis of distributive operator *dou* by extending the approach proposed in Lin (1998) to cases where *dou* distributes over various restrictors, such as mass nouns and spatial nouns, as well as temporal terms. In order to capture the interaction between *dou* and its restrictors, two levels of distributivity are explored. A new analysis of partition operator *mei* "every" and *zheng* "whole", which usually co-occur with *dou,* is also proposed.

Lin (1998) argued that *dou* is a generalized distributive operator that carries universal force. It introduces a tripartite structure, including the restrictor, the operator and the nuclear scope (Heim, 1982; Lin, 1998). For example, *dou* in sentence (1) draws forth a tripartite structure as shown in (2). *Dou* distributes the property represented by the VP over every member of the restrictor. In the case of sentence (1), supposing that there are three tortoises in the context, *dou* distributes the property "plant orchids" to each of the tortoises.

(1) Wugui dou zhong-le lanhua.
tortoise all plant-ASP orchid
'The tortoises all planted (a) orchid(s).'

(2) tortoise dou plant orchids
[restrictor] D-operator [nuclear scope/property]

Many researchers found that it is difficult to give a precise definition of the semantics of *dou*, mainly because *dou* could appear in a large variety of contexts. There are at least two approaches define the semantic status of *dou* aiming to explain why *dou* could appear in such various contexts. The first approach is attributing the complexity of *dou*'s distribution to *dou*'s dual or even triple status. For example, Pan (2005) argued that *dou* without other quantifiers or distributors is an adverbial universal quantifier, which can be taken as a distributor in some cases, and *dou* is an overt realization of a matching function when occurring with determiner universal quantifier (D-UQ) *mei*. The second approach unifies the analysis of *dou* by proposing a most simple semantic content of *dou*, while attributing the complexity of the distribution of *dou* to the variety of its restrictors. Here we take the second approach.

We believe two notions defined in Schwarzschild (1996) and Champollion (2010), *Cov* and *ε(K)(f(y))* would be helpful for us to give a coherent and unified explanation of *dou* and its restrictors. We suppose that *dou* distributes over a cover[1] based on restrictors such as plural NPs, mass NPs or quantified NPs. For instance, the plural NPs, *boys,* may refer to either one cover shown in (3), when there are three boys in the context. The context determines which cover in (3) might be chose as the restrictor.

(3) a. {{Dick, Jack, Tim}}

b. {{Dick}, {Jack}, {Tim}}

c. {{Dick, Jack}, {Tim}}

d. {{Jack, Tim}, {Dick}}

e. {{Dick, Tim}, {Jack}}

According to Schwarzschild (1996), *Cov* is a variable that obtains its value from the contexts so that it can choose a proper cover into which a distributive operator distributes. In Champollion (2010), *ε(K)* in *ε(K)(f(y))* is a threshold whose value is given by the contexts, determining the size of the parts by comparing the parts with

[1] The definition of cover is given as follows (Schwarzschild 1996, p. 70)
C covers A if:
1. C is a set of subsets of A
2. Every member of A belongs to some set in C.
3. ∅ is not in C

the entity denoted by the restrictor. *f(y)* is a very small value that satisfies *ε(K)*, in the other words, it decides that the parts should be very small comparing to the entity. Finally *y* represents a very small part cut from the entity. With these two notions, distribution of quantifiers over atomic and non-atomic references can both be handled by semantics.

Sentence (4) is an example of *dou* distributing into plural entities.

(4) Wugui dou pachu-le dongkou.
tortoise all crawl-out-ASP cave
'The tortoises all crawled out of the cave.'

(5) ∀X [X∈*Cov*([[tortoises']]) →crawled-out-from-the-cave' (X)]

The semantic representation of (4) is shown in (5). Since the predicate *pa* "crawl" in sentence (4) takes only single participant as its argument, *Cov* is assigned a value as a cover of single atoms. Supposing that there are three tortoises in the context, the cover of single atoms is {{tortoise 1}, {tortoise 2}, {tortoise 3}}, and this is the cover which *dou* distributes into.

When the predicates could take multi-participants as their arguments, the value of *Cov* can be a cover of sums of atoms. Consider (6), for example. *Dou* in (6) may distribute into a cover of atomic singletons, just as what it does in (4), or distributes into a cover of sums of atoms. Again, supposing that there are seven children (three boys and four girls) in the context, then the cover of sums of atoms is {{boy 1⊕ boy 2 ⊕ boy 3}, {girl 1 ⊕ girl 2 ⊕ girl 3 ⊕ girl 4}}. So an intermediate reading that is available is: The three boys earned 7 dollars together, and the four girls also earned 7 dollars together. The representation is shown in (7). However, the representation does not work when a mass noun is placed in the distributive key of *dou*, as Sentence (8) shows.

(6) Haizi-men (nanhai-men he nvhai-men) dou zheng-le 7-kuai qian.
child-PLU (boy-PLU and girl-PLU) all earn-ASP 7-CL money

'Children (boys and girls) all earned 7 dollars.'

(7) $\forall X\ [X \in Cov([[\text{children}']])] \rightarrow \text{earned-7-dollars}'(X)\ ]$, where *Cov* receives a value of a cover as $\{\{\text{boy } 1 \oplus \text{boy } 2 \oplus \text{boy } 3\}, \{\text{girl } 1 \oplus \text{girl } 2 \oplus \text{girl } 3 \oplus \text{girl } 4\}\}$[2].

(8) Jiu Yuehan dou he-le.

wine John all drink-ASP

'The wine has all been drunk by John.'

(9) $\forall x\ [x \leq [[\text{wine}']] \wedge \exists y[\varepsilon([[\text{wine}']])(f(y))\ ] \wedge x=y \rightarrow \text{drunk-by-john}'(x)\ ]$[1]

Since the entity which the mass noun *wine* in Sentence (8) refers to is not countable, the value of *Cov* can only be an entity, and thus could not be distributed. But if we assume *dou* here distributes into minimal parts of the reference of *wine*, we will still encounter minimal-parts problem: it is hard to decide what exactly size a minimal part should be so that each part of the wine was drunk by John in (8)[3]. But this problem can be solved by applying $\varepsilon(K)(f(y))$. A new representation of (8) is shown in (9), which means for every very small part of the wine (comparing to the amount of wine in the context), x, the size of which satisfying f(x), x was drunk by John.

The phenomenon that *dou* distributes over single nouns can also be analyzed in this way. An example is given in (10) and (11) is the representation of (10). So does the distributivity over spatial and temporal terms. Consider (12) and (13), for example. The representation of (12) is shown in (14), and that of (13) is shown in (15).

(10) Zhe-ge pingguo dou bei Yuehan chi-le.

this-CL apple all be John eat-ASP

'This apple is all eaten by John.'

(11) $\forall x\ [x \leq [[\text{this-apple}']] \wedge \exists y[\varepsilon([[\text{this-apple}']])(f(y))\ ] \wedge x=y \rightarrow \text{eaten-by-john}'(x)]$

(12) Zhe duan shijian Yuehan dou zai jia.

this period time John all at home

[2] "$\oplus$" and "$\leq$" indicate sum operator and partial-of operator respectively (see Link 1983).
[3] Please refer to Champollion, 2010 for detailed discussion.

'This period of time John will be (all) at home.'

(13) Zhuozi-shang dou shi shu.

table-above all be book

'The table is (all) full of books.'

(14) $\forall$x [x≤[[this-period-of time']]∧∃y[ε([[this-period-of-time']])(f(y))]∧x=y→ john-is-at-home' in (x)]

(15) $\forall$x [x≤[[table']]∧∃y[ε([[table']])(f(y))]∧x=y → there-is-book-on' (x)]

Even in the situation "I went out for 3 minutes" or "Some space of the table does not have any book", (12) and (13) are still true. This is exactly what the thresholds ε([[this-period-of-time']]) and ε([[table']]) predict, since they requires that f(y) should be above some threshold compared to the entities, i.e. "this period of time" in (12) and "the table" in (13).

Champollion (2010) suggests that *ε(K)(f(y))* can be applied to distributivity over plural nouns as well, but we would like to restrict it to non-atomic references. We argue that there are two levels of distributivity in natural languages, i.e. the level of atoms/sums of atoms and the level of sub-atoms. Mandarin Chinese provides two corresponding operators, *mei* "every" and *zheng* "whole", being used at atomic and non-atomic levels of distributivity respectively.

(16) Mei liang-ge ren dou qi-zhe * (yi-pi) ma.

every two-CL people all ride-ASP (one-CL) horse

'Every two people are riding * (one) horse.'

(17) Zheng-ge ren dou gandao (*liang-ci) tong.

Whole-CL body all feel (two-time) pain

'The whole body is all (*two times of) aches.'

Sentence (16) is ungrammatical when the number-classifier construction is absent, and so is sentence (17) where number-classifier construction is presented. This is because *mei* "every" is a atoms/sums of atoms level partition operator, while *zheng* "whole" a sub-atoms level partition operator. Kratzer (1998) proposed that indefinite NPs are obliged to go through skolemization or some analogous process. By analyzing sentences (16) and (17) following Kratzer's proposal, we find skolemization must be applied to the level of atoms/sums of atoms, but not to the sub-atoms level. Since *mei* is a atoms/sums of atoms level partition operator, it chooses a numeral phrase *yipi ma* "a horse" for skolemization in (16) (S. Z. Huang, 1996); *zheng* is a sub-atom level partition operator, so it is not available for skolemization, resulting in the numeral NP *liangci tong* "two times of aches" being redundant.

Along this line of reasoning, (16) can be represented as (18), and (17) can be translated as (19). As you can see, (18) is the distributivity at the level of atoms/sums of atoms, so we use the corresponding variable *Cov*; (19) is the distributivity at the level of sub-atoms, so we use the variable $\varepsilon(K)(f(y))$.

(18) $\exists f\ \forall X(X \in Cov\ ([[\text{two-people}']]) \wedge \text{one-horse}'\ (f(X)\ ) \rightarrow \text{are-riding}'\ (X,\ f(X)\ ))$,

(19) $\forall x\ [x \leq [[\text{body}']] \wedge \exists y[\varepsilon(\text{body}')(f(y))] \wedge z{=}x \rightarrow \text{be-ache}'\ (x)]$.

Experimental studies on domain restriction in Child Mandarin

Our theoretical analysis shows that the core distributive computation drawn by *dou* is simple and straightforward: *dou* distributes the property denoted by the VP to every member of the restrictor. What complicates the procedure is that there are a large variety of restrictors. We therefore predict that for children, the core distributive computation is simple and could be acquired at a young age, while children may have problems processing or acquiring distributive computation containing complicated restrictors. In this part, we present data of three experiments that confirmed our predictions.

Studies on children's competence in processing distributive quantifiers draw seemingly controversial conclusions. Much previous research has investigated children' understanding of sentences containing distributive quantifiers, yet it remains under discussion whether or not children are competent with the distributive computation associated with distributive quantifiers (e.g., Roeper & de Villiers, 1991; Roeper, Pearson, & Grace, 2011; Philip, 1995; Crain et al., 1996; Geurts, 2003; Drozd, Musolino & van der Lely, submitted). Therefore, this study investigates Mandarin-speaking children's interpretation of sentences containing the distributive quantifier *dou*, aiming to provide new insights into our understanding of children's comprehension of distributive quantifiers.

As was mentioned in the theoretical part, *dou* in Mandarin Chinese is generally assumed to be a distributive operator which distributes the property denoted by VPs over the plural NPs (Lin, 1998). It introduces a tripartite structure at LF: [α] *dou* [VP]. In this representation α denotes the restrictor of *dou*, over which *dou* distributes the property denoted by the VP. In this study, three experiments were designed to explore whether four to five year old Mandarin-speaking children have the knowledge that *dou*, as a distributive operator, distributes the property denoted by the predicate over the restrictor. In particular, we looked at the cases where two potential restrictors of *dou* are provided.

Experiments

The first experiment used a variant of the Truth Value Judgment Task (Crain & Thornton, 1998). The task involved two experimenters. One acted out stories using pictures, and the other played the role of a puppet who watched the stories alongside the participant. After each the story, the puppet attempted to tell the participant what he thought had happened in the story using a test sentence. The participant's task was to judge whether or not the puppet was correct. Twenty-five children (mean age 4;10, range from 4; 01 to 5; 03) and forty-one adults participated in the experiment. A typical test sentence is given in (20), in which there are two plural NPs to the left of *dou*: *wugui* "tortoise" and *laoying* "eagle"[4]. Both of the NPs can be the restrictor of *dou*. The test sentence was presented following either a scenario in Figure 1

[4] Mandarin Chinese does not have morphological distinctions between singulars and plurals, so both NPs *wugui* "tortoise" and laoying "eagle" in (20) can be interpreted either as a singular or as a plural.

(corresponding to the reading in which *dou* distributes over *laoying* "eagle") or a scenario in Figure 2 (corresponding to the reading in which *dou* quantifies over *wugui* "tortoise").

(20) Wugui zai laoying pangbian *dou* zhong-le lanhua.
tortoise at eagle side all plant-ASP orchid
'The tortoise(s) at the eagle(s) side all plant orchid(s).'

Figure 1: 

Figure 2: 

The results show that adults accepted test sentences like (20) in a scenario like Figure 1 78.7% of the time, but they only accepted the same sentences in a scenario like Figure 2 22.7% of the time. Children, on the other hand, accepted the test sentences in both scenarios equally often (41.7%). The findings suggest that adult Mandarin-speakers tend to associate *dou* with the closest element it can distribute over. Four-year-old Mandarin-speaking children, however, are still uncertain about which element is the proper restrictor of *dou*. Therefore, they are more flexible in deciding which element should be the restrictor of *dou*.

However, an acceptance rate of 41.7% indicates that children might have difficulties in processing sentences with two potential restrictors close to each other, especially when these two NP constitute a complicated syntactic structure [NP [P NP]]. In order to see whether children are able to find the correct restrictor of *dou* when the two plural NPs are separated in which condition they would not be disturbed by the complicated structure, a second experiment was conducted. Again, we used the Truth Value Judgment Task. Twelve children (mean age 4;11, range from 4;7 to 5;1) were tested. Example (21) illustrates a typical test sentence.

(21) Xiaodongwu-men dou reng-diao-le dianshi, chuang, he bingxiang.
animal-PLU all chunked-away-ASP TV, bed, and fridge
'The animals all chunked the TV, bed and fridge away.'

The test sentence was presented following a story in which one animal chunked a TV and a bed away, and the other chunked a TV and a fridge away. The prediction is that if children restricted the domain of *dou* to the elements to its left, then they would reject the text sentence, since neither of the two animals chucked all the three appliances away; if, on the other hand, children took the conjunct NP *dianshi, chuang, he bingxiang* 'the TV, the bed and the bridge' as the restrictor of *dou*, then they should accept the test sentence. The finding was that children accepted the test sentences 79% of the time, and rejected them only 21% of the time, and adults rejected the test sentence by 93%. We take this as evidence that children are more flexible than adults in restricting the domain of the distributive operator *dou*. When more than one plural NPs are present, children would take either of them to be the restrictor of *dou*, even in cases where some of the NPs are to its right, namely outside the syntactic scope of *dou* (see Lee, 1986).

The third experiment focuses on children's selection of the restrictor when there is a plural NP to *dou*'s left and a wh-phrase to its right. In this experiment, we asked children and adults questions as shown in (22) given a story depicted in Figure 3.

(22) Xiaodongwu-men dou zhaodao-le shenme baobei?
animal-PLU all find-ASP what treasure
'What are animals all found?'

Figure 3:

In the story corresponding to Figure 3 and question in (22), the dog found a gem and a car, and the pig found a gem and a shell (the experimenter told the subjects all these four objects were treasures). Every subject was asked four test questions in the same pattern with (22) and four fillers. Fillers were simple questions about peripheral information in the story, and were designed to conceal our question pattern and make the task more interesting. For instance, in the condition of Figure 3, we asked a question like "What did the dog find?" as a filler item. We recruited twelve children (mean age 4; 9, range from 4;7 to 5;1) from the kindergarten at Beijing Language and Culture University and ten university students from Beijing Language and Culture University.

The answers of the subjects were recorded, and were then classified into three categories:

1. **List answer**, for example, "the dog found a gem and a car, and the pig found a gem and a shell".

2. Single answer, for example, "a gem/gems".

3. Collective answer, for example, "gems, a car and a shell".

We believe these three sorts of answers to the test questions are derived from the following three kinds of interpretations of the ambiguous questions.

I. *dou* quantifies over the plural NP *xiaodongwumen* "animals" in (21) with functional reading[5]:

(23) $\lambda p \exists f [p = \forall x$ [animal'(x) $\wedge$ treasure'(f(x)) $\rightarrow$ find (x, f(x))]], where f is a variable of type (e, e).

(23) means "Tell me p, where p is 'for every x, exist some f mapping each x to some treasure f(x), so that x found f(x)'."

II. *Dou* quantifies over the plural NP *xiaodongwumen* "animals" in (22) without functional reading:

(24) $\lambda p \exists x$ [treasure' (x) $\wedge$ $\forall y$ [animal'(y) $\rightarrow$ found (y, x)] $\wedge p =$x]]

(24) means "exist some x, x is a treasure, for every y, if y is an animal, y found x. Tell me x."

III. *Dou* quantifies over wh-phrase in (22):

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[5] Please refer to (Chierchia, 1993) for detailed discussion on functional reading.

(25) $\lambda p \exists x$ [animal'(x) $\wedge \forall y$ [treasure'(y) $\rightarrow$ found (x, y)] $\wedge p = y$]

(25) means "exist x, x is an animal, for every y, if y is a treasure, x found y. Tell me y."

The results show that the children offered 54.2% list answers, 43.8% collective answers and 2.0% single answers. This is striking because the adults had a totally different pattern: they gave 10% list answers, 10% collective answers and 80% single answers. So children could choose either the plural NPs to *dou*'s left or the wh-phrases to *dou*'s right as the restrictors, and the possibilities of these two choices are almost the same. But for adults, they tended to choose the plural NPs as the restrictors. Therefore, the results confirm our argument that children are more flexible than adults in domain restriction with *dou*-distribution.

But why were list answers and collective answers rare in adults' answers? We believe that this problem would be easily resolved if we adopt a well-known idea of C. T. J. Huang (1982) that wh-phrases in Chinese go through covert movement on the Logical Form. After the movement, both the wh-phrase and the plural NP are at the left side of *dou*. In the light of the results of our first experiment, adults may only choose the candidate closest to *dou* as its restrictor. Since the wh-phrases always have scope over the plural NPs, they are always farther from *dou* comparing to the plural NPs. As a result, adults chose the plural NPs rather than the wh-phrases as the restrictors of *dou*.

The present study sheds light on the debate whether or not children are capable of performing the computational process of distributive operator. The findings of the three experiments invite us to conclude that four to five year old children are able to execute the core computational procedure of distributivity. Children have the knowledge that a distributive quantifier distributes the property denoted by the VP to the restrictor. The non-adult interpretations of children can be attributed to the fact that children assign different restrictors to the quantifier than adults do. We propose that children will become adult-like in processing distributive quantifiers once they assign the same restrictors as adults do.

Combing our theoretical and experimental study together, we find that the core distributive computation is simple in Chinese, as in any other languages. However, distributive computation is usually complicated by the restrictor of the distributive operator. We propose that languages have two levels of distributivity: the level of atoms and sums of atoms and the level of sub-atoms, and *dou*-distributivity occurs at both levels. We further predict that children may be capable of core distributive computation when they are very young, but they may encounter problems when processing sentences with complicated restrictors. The prediction bore out in all our three experiments, and we found that the children were different from the adults because they were flexible in domain restriction.

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