Syntactic Constraints on Quantifier Domains:
An Experimental Study of the quantifier *dou* in Mandarin Chinese
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Which NP does *all* associate with in 'The pandas, the children have all seen", *the pandas* or *the children,* or both? Certainly *the children*? The intuition of Mandarin native speakers does not work for a Mandarin counterpart though. We present experimental results on adults' interpretation of the adverbial universal quantifier *dou* 'all' in Mandarin Chinese. This is the first experimental study on syntactic constraints on the quantifier domain of *dou*, although there has been extensive theoretical discussion of its properties. We advance the hypothesis that c-command is the relation computed by speakers in determining which NP *dou* quantifies over (the domain of *dou*), whereas an analysis based on a locality restriction are not operative in the domain we explore, contra previous theoretical proposals.

Previous analyses and experimental questions: Cheng (1995) argues that *dou* moves to adjoin to the NP it quantifies over at LF. To explain blocking effects in *dou* quantification, Cheng (1995) applies a Principle of Economy of Derivation (PED) (Chomsky, 1991), taking *dou* to make only the shortest move, attaching to the closest m-commanding NP as its domain. The more distant NP is not available for *dou*. Cheng analyzes left dislocation sentences like (1), where both the topic and subject m-command *dou*. **Cheng's PED approach predicts that only the subject *women* 'we' can be quantified by *dou* because it is closer, thus predicting that only meaning (ii) is possible in (1).** (Cheng takes (1) as ambiguous though, without explaining why *dou* quantification over the further *zhexie xuesheng* 'these students' does not violate PED).

1) [$_{CP}$ [zhexie xuesheng]$_i$ Top [$_{ASPP}$ [pro$_i$ [$_{ASP}$ women dou xihuan t$_i$]]]
          these students   we   all   like

i) "For all of these students, we like them."   **ii**) "For the students, all of us like them."
iii) "For all of these students, all of us like them."

Zhang (1997) analogizes *dou* to an anaphor, and proposes that either one or all of the NPs that asymmetrically c-command *dou* can associate with *dou* by multiple linking. Therefore, **Zhang's theory predicts a three-ways ambiguity (meaning i, ii and iii)**. Lin (1996, 1998) treats *dou* as a generalized distributive operator. It distributes over a particular element by binding a trace that is left by the element being moved to/through the Spec of a Distributive Phrase headed by *dou*. Therefore **either the trace of the topic** (he assumes topicalization, not left dislocation) **or the trace of the subject** (he adopts the VP-internal subject hypothesis) **but not both simultaneously** can be bound by *dou* predicting either interpretation **i** or **ii**. Both Zhang and Lin require *dou* to be c-commanded by its domain.

Considering the distinct predictions of the previous theories, our experimental questions are: which NP(s) will *dou* quantify over when there are two NPs available? Must the domain of *dou* c-command *dou*? However, we suggest that sentences such as (1) *are not the best testing condition*, because both the topic and subject are plural and have a preferred exhaustive interpretation which is not distinguishable from universal force in most cases (e.g. *we left* means *we all left*). In (1), *zhexie xuesheng* 'these students' is usually synonymous with "ALL OF these students" even in the absence of the quantifier *dou*. Therefore*, our experiment uses bare nouns* rather than plurals or demonstrative phrases, because bare nouns in Mandarin are ambiguous between a singular and a plural interpretation without additional context. Crucially, when a bare noun is quantified by *dou*, an obligatory exhaustive (hence plural) interpretation is obtained. We use this interpretation as a diagnosis for *dou* quantification over bare nouns.

Experiment: 40 native speakers of Mandarin Chinese (mean age 22.9) were recruited in Beijing, China. We used a Truth Value Judgment Task (Crain & Thornton, 1998), in which the experimenter told the subject a series of stories (contexts), acted out with pictures and toys. The experimenter then uttered a description of the story (the test sentence), asking the subject to judge if it was true or false and to explain why. This experiment contained 6 conditions, three sentence types (ST) and two types of contexts/stories (CT) (3 × 2). Due to space limitation we discuss only materials of the first 4 conditions, from 2 STs (examples in (2)-(3)). STs in (2) differed regarding the c-command relation between the NPs and *dou.* For CT1 and CT2 in (3), only one of the two NPs, either NP1 or NP2, could be felicitously quantified by *dou,* thus must be interpreted as plural/exhaustive, and the other NP required a singular interpretation. The experiment normally lasted approximately one hour. The following are typical examples of test sentences with their contexts (2 × 2). In the actual test the stories and characters were systematically varied. Notice that in the experiment, we tried to keep the two NPs equally salient in the context, *e.g.* by balancing the occurrences of the two NPs.

(2) a. *ST 1*: [[**Xiongmao**]_{NP1} [**dou wei-le**   [**tuzi**]_{NP2}]]. (NP1, but not NP2, c-commands *dou*)
             panda   all feed-ASP rabbit
   i. 'One and only one rabbit was fed by all of the pandas.' (*T in CT1*; F in CT2)
   ii. or 'One and only one panda fed all of the rabbits.' (*T in CT2*; F in CT1)
  b. *ST 2*: [[**Tuzi**]_{NP2}, [[**xiongmao**]_{NP1} **dou wei-le**]]. (both NP1 and NP2 c-command *dou*)
             rabbit,   panda   all feed-ASP
   i. 'One and only one rabbit was fed by all of the pandas.' (*T in CT1*; F in CT2)
   ii. or 'One and only one panda fed all of the rabbits.' (*T in CT2*; F in CT1)
(3) a. *CT 1*: One and only one of the two rabbits was fed by both pandas.
  b. *CT2*: One and only one of the two pandas fed both rabbits.

Results and Discussion: As shown in Table 1, for ST1 in CT1 and CT2 (Condition ST1_CT1 and ST1_CT2 respectively), participants accepted a singular (non-exhaustive) interpretation of the object NP1 in ST1_CT1 (2a*i*) but rejected the singular interpretation of the subject in ST1_CT2 (2a*ii*). This indicates that only the subject NP1, which c-commands *dou*, can be *dou*'s domain, whereas the object NP2 which does not c-command *dou*, cannot. For ST2 conditions, the participants accepted either the topic (ST2_CT2, 2b*ii*) or the subject (ST2_CT1, 2b*i*) as the domain of *dou*, although they clearly prefer the (non-local) topic as the domain.

Table 1: Acceptance rate of test sentences under two context types				
Conditions	ST1_CT1 (sd)	ST1_CT2 (sd)	ST2_CT1 (sd)	ST2_CT2 (sd)
Accept. rate	*94.9% (1.97)*	0.9% (0.84)	26.7% (3.96)	*85.8% (3.12)*

  Our results suggest that *dou* can quantify over either NP in the topic sentences (ST2 conditions), with a strong preference for the non-local domain, the topic, thus not supporting Cheng's PED account of *dou*-quantification. Cheng's analysis predicts that in such sentences, *dou* quantifies over only the closest NP, i.e. the subject. The results also do not support the argument that both of the NPs are quantified by *dou* at the same time, failing to corroborate Zhang's (1997) approach. Both NPs being quantified means 'all the pandas fed all the rabbits': both NPs must be interpreted as exhaustive and therefore at least some subjects would have overwhelmingly rejected ST2 under both CTs. But further results reveal that no participants rejected both. In addition, the contrast between the results of ST1 conditions indicate that only the NP which c-commands *dou*, i.e. the subject, and not the object, can be the domain of *dou*. In sum, given these experimental results, if there are multiple NPs c-commanding *dou*, <u>either one of them</u>, but <u>not both simultaneously</u>, can be *dou*'s domain, supporting Lin's (1996, 1998) theory.