Syntactic Constraints on Quantifier Domains: An Experimental Study of the quantifier 

Alan Hezao Ke, Sam Epstein, Rick Lewis and Acrisio Pires, University of Michigan

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], Top [ASPP [proi [ASPP women dou xihuan ti]]] 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)
   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)
   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. **CT 2:** 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 (2ai) but rejected the singular interpretation of the subject in ST1_CT2 (2aii). 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, 2bii) or the subject (ST2_CT1, 2bi) as the domain of dou, although they clearly prefer the (non-local) topic as the domain.

<table>
<thead>
<tr>
<th>Conditions</th>
<th>ST1_CT1 (sd)</th>
<th>ST1_CT2 (sd)</th>
<th>ST2_CT1 (sd)</th>
<th>ST2_CT2 (sd)</th>
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<tr>
<td>Accept. rate</td>
<td>94.9% (1.97)</td>
<td>0.9% (0.84)</td>
<td>26.7% (3.96)</td>
<td>85.8% (3.12)</td>
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</table>

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, either one of them, but not both simultaneously, can be dou’s domain, compatible with Lin’s (1996, 1998) theory.