Dou and plural universal quantification in Mandarin Chinese

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Introduction

- Mandarin Chinese uses a combination of determiner-like *mei* and adverb-like *dou* to express universal quantification; in most cases, *dou* is obligatory:
  (1) **mei** yi-ge xuesheng *(**dou**) hui shuo yingyu.
  MEI 1-CL student DOU can speak English
  'Every student can speak English.'
- Like *every*, *mei* can be used with numerals larger than one.
- Then, *dou* is no longer always required; there is a semantic alternation with the presence or absence of *dou* between the **exhaustive** and **partition** readings, introduced in Sun (2018).
- If there are 4 students in the context,

Exhaustive reading	Partition reading
With *dou*, 'mei-*n*-NP dou VP' quantifies over every possible *n*-sized plurality. 'mei-2-NP' quantifies over $\binom{4}{2} = \frac{4\cdot3}{2\cdot1} = 6$ pluralities.	Without *dou*, 'mei-*n*-NP VP' is only licensed when the VP contains a numeral. A partition of the domain into *n*-sized pluralities is quantified over. 'mei-2-NP' quantifies over $\frac{4}{2} = 2$ pluralities.

(2) **mei** liang-ge xuesheng *(**dou**) xie-le yi-pian lunwen. ⇒ 6 papers
MEI 2-CL student DOU write-PFV 1-CL paper
'Every possible pair of students co-wrote a paper.'

(3) **mei** liang-ge xuesheng (***dou**) xie-le yi-pian lunwen. ⇒ 2 papers
'Every pair in a partition of the students into pairs co-wrote a paper.'

- What is the semantics of *dou*? How is *dou* responsible for the semantic alternation?

An *even* analysis of *dou*: Liu (2021)

- Liu (2021) equates *dou* with English *even*; it contributes this exact meaning with a singular DP associate (4):

(4) Zhangsan **dou** lai-le.
Z. DOU come-PFV
'Even Zhangsan$_F$ came.'

- The semantics of *dou* is therefore

(5) $[\![\text{dou}_C\ S]\!]$ is defined only if $\forall q \in \{[\![S']\!] \mid S' \in \text{ALT}(S)\} \cap C.\ [\![S]\!] \neq q \rightarrow [\![S]\!] < q$.
If defined, $[\![\text{dou}\ S]\!] = [\![S]\!]$.

It is a propositional filter that presupposes the prejacent is the strongest w.r.t an ordering (likelihood or entailment) among its alternatives.

- *Mei* is a regular universal quantifier: $[\![\text{mei}_D]\!] = \lambda P_{et}.\lambda Q_{et}.\forall x_e.\ x \in D \wedge P(x) \rightarrow Q(x)$
- The associate of *dou* in such sentences is the domain variable on *mei*. The alternatives generated are the subdomain alternatives. Suppose a, b, c are students in the context,

(6) mei_D yi-ge xuesheng *(dou) lai-le.
MEI 1-CL student DOU come-PFV
'Every student came.'
$\forall x.\ x \in \{a, b, c\} \rightarrow \text{CAME}(x)$

Domain alternatives of (6)
$\forall x.\ x \in \{a\} \rightarrow \text{CAME}(x)$
$\forall x.\ x \in \{b\} \rightarrow \text{CAME}(x)$
$\forall x.\ x \in \{c\} \rightarrow \text{CAME}(x)$
$\forall x.\ x \in \{a, b\} \rightarrow \text{CAME}(x)$
$\forall x.\ x \in \{b, c\} \rightarrow \text{CAME}(x)$
$\forall x.\ x \in \{c, a\} \rightarrow \text{CAME}(x)$
$\forall x.\ x \in \{a, b, c\} \rightarrow \text{CAME}(x)$

- The alternatives are all entailed by the prejacent.
- *Dou*'s presupposition is satisfied, and (6) just means 'every student came.'
- Maximize Presupposition derives the obligatoriness of *dou* for (5).

(7) *Maximize Presupposition* (MP)
Make your contribution presuppose as much as possible (Heim 1991).

- Since the presupposition of *dou*, i.e., that the prejacent is the strongest, is met, its use is obligatory since one has the duty to presuppose maximally.
- The hope is for this presupposition of *dou* to account for the alternation.
- Two supplements to Liu (2021) are required.

Supplement 1: Inherent ambiguity of universals

- First, plural universal quantifiers are inherently ambiguous between the exhaustive and partition readings.
- This is seen in the English examples with *every*; (8) and (9) are paired with their most salient interpretations:

Every two students shook hands. ⇒ all possible pairs ⇒ $\binom{n}{2}$ handshaking events	Every two students co-wrote a paper. ⇒ pairs in a partition ⇒ $\frac{n}{2}$ papers written

- This ambiguity can be captured through the domain variables on the universal quantifiers as in (8), (9):

Exhaustive reading	Partition reading
D_{exh} is the closure under $\oplus$ of the set of contextually salient atoms in $[\![\text{NP}]\!]$ (Crnič 2022).	D_{part} is different from D_{exh} in that the *n*-sized pluralities form a partition of $\bigoplus D_{\text{exh}}$.

Supplement 2: Sub-domains redefined

- Second, the restriction that domain alternatives involve only subdomain (implicit in Liu 2021) should be relaxed.
- It is just that when the domain is the closure under $\oplus$ of the contextually salient atoms, no larger domain can be constructed. In principle,

Domain alternatives

Given a domain D, if $\bigoplus D' \sqsubseteq \bigoplus D$ (so D' does not involve atoms not involved in D), D' should be a domain alternative of D even if $D' \not\subseteq D$.

Old: $D' \subseteq D$	New: $\bigoplus D' \sqsubseteq \bigoplus D$

- Now, D_{exh} and D_{part} are each other's alternatives since they involve the same atoms, $\bigoplus D_{\text{exh}} = \bigoplus D_{\text{part}}$.

Explaining the alternation

- Then, the alternation is explained: *dou*'s presupposition is met in the exhaustive but not in the partition.
- I assume (8)–(11) for *mei*, *n*-CL NP, and the domains involved:
  (8) $[\![\text{mei}_D]\!] = \lambda P : |D \cap P| \geq 2.\lambda Q.\forall x \in D \cap P.\ Q(x)$
  (9) $[\![n\text{-CL NP}]\!] = \lambda X.\ |X| = n \wedge X \in *[\![\text{NP}]\!]$
  (10) Domain of 'mei-*n*-NP' with *dou*: D_{exh}
  (11) Domain of 'mei-*n*-NP' without *dou*: D_{part}
- Then, suppose the atomic students in the context are a, b, c, d,
  (12) $\text{mei}_{D_{\text{exh}}}$ 2 student *(dou) co-wrote a paper. ⇒ 6 papers
  $\forall X \in D_{\text{exh}} \cap [\![2\ \text{student}]\!] = \{a\oplus b, a\oplus c, a\oplus d, b\oplus c, b\oplus d, c\oplus d\}.\ \text{WRITE.PAPER}(X)$
  (13) $\text{mei}_{D_{\text{part}}}$ 2 student (*dou) co-wrote a paper. ⇒ 2 papers
  $\forall X \in D_{\text{part}} \cap [\![2\ \text{student}]\!] = \{a \oplus b, c \oplus d\}.\ \text{WRITE.PAPER}(X)$
- When $n \geq 2$, as $|D \cap P| \geq 2$, we have $D_{\text{part}} \subset D_{\text{exh}}$.
- In (12), D_{exh} is the maximal domain, so the prejacent entails all the alternatives; the presupposition of *dou* is met; and *dou* is obligatory by MP.
- In (13), D_{part} is not maximal, so the prejacent doesn't entail all the alternatives; the presupposition of *dou* is not met; and *dou*'s presence is impossible.
- When $n = 1$, $D_{\text{exh}} = D_{\text{part}}$; as these domains are equally maximal, *dou* is obligatory. This is just the scenario of Liu (2021).

Extension to plural free choice (FC) indefinites.

- The present approach predicts that when an element requiring that the prejacent be the strongest among the alternatives (*dou*, *even*) associates with the domain variable of a sentence expressing a universal proposition, should have the maximal domain.
- Then, the prediction is that when an NPI indefinite under a universal FC reading involves a numeral $n \geq 2$, it is always the **exhaustive** rather than the **partition** reading, if we adopt the following:

Lahiri (1998) and Crnič (2017, 2022)

NPIs are weak elements that are associates of *even*.

- Suppose the domain variable on *any D* is D_{part} in (14).
  (14) $\varnothing_{\text{even}}$ [Exh^{IE+II} any_D two students can co-write a paper].
- By *Innocent Inclusion* (Bar-Lev & Fox 2020), (14) should mean that every pair in a partition of salient students into pairs can co-write a paper (**partition**).

The algorithm of Innocent Inclusion is agnostic w.r.t. whether the pluralities are exhaustive or form a partition.

- However, (14) clearly doesn't have this meaning; rather, it must mean that all possible pairs of students can co-write a paper (**exhaustive**).
- This is because $\varnothing_{\text{even}}$'s presupposition isn't satisfied when $D = D_{\text{part}}$ in (14) since replacing D_{part} with D_{exh} will result in a stronger alternative.
- D can only be D_{exh} in the presence of $\varnothing_{\text{even}}$.
- The same is true in Chinese; NPI *renhe* 'any' also forces the presence of *dou* which forces the use of D_{exh} in (15).

(15) **renhe**$_{D=D_{\text{exh}}}$ liang-ge xuesheng *(**dou**) keyi xie yi-pian lunwen.
any 2-CL student DOU can write 1-CL paper
'Any two students can write a paper (together).'

- (15) only means that all possible pairs of students can co-write a paper, not just pairs in a partition.
- This connection between plural universals and plural FC indefinites cannot be captured by analyses of *dou* without an *even*-like semantics, e.g. Sun (2018), who considers *dou* a plain universal quantifier and posits that there is a covert *dou* imposing the partition requirement and used in the partition reading instead of overt *dou*.

Conclusion

- 'Mei-*n*-NP (dou) VP' alternates between exhaustive and partition readings when $n \geq 2$, depending on whether *dou* is present.
- The account of *mei-dou* occurrence in Liu (2021) can account for this alternation if we entertain the following:

Plural universal quantification is inherently ambiguous between exhaustive and partition readings, captured through domain variables.

Domain alternatives are not necessarily subdomain alternatives; the requirement $D' \subseteq D$ is replaced by $\bigoplus D' \sqsubseteq \bigoplus D$.

- The account also extends to universal FC plural NPIs, where the obligatory presence of *even* or *dou* forces an exhaustive reading.

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