Mandarin particle *dou*: A pre-exhaustification exhaustifier over sub-alternatives

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1. Introduction

- The Mandarin particle *dou* has various uses: ∀-quantifier, free choice item (FCI)-licenser, scalar-indicator, minimizer-licenser, ...

∀-quantifier: In a basic declarative, *dou* is associated with a plural item and ∀-quantifies over it.

(1) [Tamen] *dou* dao -le.
   they DOU arrive -ASP
   ‘They all arrived.’

FCI-licenser: When associated with a wh-item/disjunction, *dou* evokes a ∀-FC reading.

(2) [Shei] *(dou)* hejiu.
(3) [Yuehan huoze Mali] *dou* keyi jiao jichu hanyu.
   Who,FCI DOU drink John or Mary DOU can teach introduction Chinese
   ‘Anyone/everyone drinks.’ Intended: ‘Both John and Mary can teach Introductory Chinese.’

Scalar-indicator: When associated with a scalar item or occurring in a [lian ... *dou*] construction, *dou* implies that the prejacent proposition is more informative or less likely to be true than its alternatives.

(4) *dou* [wu dian]F -le.
   DOU five o’clock -ASP.
   ‘It is five o’clock.’
   ⇝ Five o’clock is very late.

(5) (Lian) *dou* chi dao -le.
   even team-leader DOU late arrive -ASP
   ‘Even the team leader was late.’
   ⇝ The team leader is less likely to be late.

Minimizer-licenser: *dou* licenses the minimizer “one+CL+NP” in a [lian ... *dou* negate] construction.

(6) Yuehan (lian) yi-ge ren *(dou) *(mei) qing.
   John even one-CL people DOU NEG invite
   ‘John even didn’t a single person.’

- I propose that *dou* is an exhaustivity operator that (i) operates on sub-alternatives and (ii) has a pre-exhaustification effect. Roughly:

(7) *[dou][P(x)] = P(x) and not only P(x’ (x’ is a subpart of x, a weak scale-mate of x, a sub domain-alt of x, ...)

For example:

(8) a. [[A and B] *dou* came] = A and B came, not only A came, and not only B came.
    b. [Dou [it is five o’clock]] = It’s 5 o’clock, not just 4 o’clock, not just 3 o’clock, ....

Roadmap
- Section 2: Introducing the grammatical view of exhaustification and defining *dou*
- Section 3: ∀-quantifier
- Section 4: FCI-licenser
- Section 5: Scalar-indicator

1 I thank Gennaro Chierchia, Danny Fox, Jim Huang, Mingming Liu, Edwin Tsai, and Ming Xiang for helpful comments and discussions. All errors are mine.
2. **Defining *dou***

- The grammatical view of exhaustifications analyzes scalar implicature (SI) as a result of covert exhaustifications. (Fox 2007; Chierchia et al. 2013; Fox & Spector to appear; a.o.)
  - a sentence containing a scalar item evokes a set of scalar alternatives;
  - a covert exhaustivity operator \( O(\approx \text{only}) \) affirms the assertion and negates the non-weaker alternatives.

\[
(9) \quad O(p) = p \land \forall q \in \mathcal{Alt}(p)[p \not\subseteq q \implies \neg q]
\]

(Chierchia et al. 2013)

\[
(10) \quad \mathcal{A}lt(\phi_{\text{some}}) = \{\phi_{\text{some}}, \phi_{\text{all}}\}
\]

- I define *dou* as a special exhaustivity operator: a presuppositional exhaustivity operator that operates on sub-alternatives and has a pre-exhaustification effect.\(^2\)

| (11) | \( \text{Sub-Alt}(p) = \{q : q \in \mathcal{Alt}(p) \land p \subset q\} \) | sub-alt = weaker-alt (to be revised) |
| (12) | \( \mathbf{dou}(p) = \exists q \in \text{Sub-Alt}(p). p \land \forall q \in \text{Sub-Alt}(p)[\neg O(q)] \) |   |
| a. | Presupposition: \( p \) has some sub-alternatives. |
| b. | Assertion: the prejacent is true, the exhaustification of each sub-alternative is false. |

For example:

\[
(13) \quad \{\text{A and B}\} \text{ dou arrived.}
\]

a. \( p = \text{A and B arrived} \)

b. \( \text{Sub-Alt}(p) = \{A \text{ arrived, B arrived}\} \)

c. \( \text{dou}(p) = A \text{ and B arrived, not only A arrived, and not only B arrived.} \)

The underlined part, while entailed by the prejacent, yields an emphatic effect.

3. **\( \forall \)-quantifier use**

3.1. More facts

- *Dou* brings up more semantic consequences than \( \forall \)-quantification. Descriptively:
  - “Distributivity Requirement”: if the prejacent sentence admits both collective and distributive/cumulative readings, applying *dou* eliminates the collective reading.

\[
(14) \quad \{A \text{ he B}\} \text{ dou jiehun -le.} \quad \text{A and B dou get-married -ASP}
\]

\[
\text{‘A and B each got married.’} \quad \text{‘A and B each got married.’}
\]

\[
\#\text{‘A and B married each other.’} \quad \#\text{‘A and B married each other.’}
\]

(15) \[Tamen\] *dou mai-le fangzi.\]

\[
\text{they dou buy-Perf house} \quad \text{‘They all bought houses.’} \quad \text{‘They together bought some houses.’}
\]

- “Plurality Requirement”: the item associated with *dou*, overt or covert, must be non-singular.

\[
(16) \quad \text{Yuehan ([mei-ci])} \text{ dou qu Beijing.} \quad \text{John every-time dou go Beijing}
\]

\[
\text{‘Every time, John *dou* goes to Beijing.’}
\]

\(^2\)This operator is close to the recursive exhaustification operation by Fox (2007) and the pre-exhaustification operator by Chierchia (2006, 2013). The latter ones are proposed mainly to deal with \( \exists \)-FC inferences.
3.2. Previous studies

3.2.1. Distributor analysis (Lin 1998)

- *Dou* is a generalized distributor distributing over covers.

\[
\text{dou}[P(x)] \text{ iff } x \in \text{dou}(\text{Cov}(P)) \text{ iff }\]

\[
\text{Cov is a cover of } x \text{ and } \forall y[y \in \text{Cov} \rightarrow P(y) = 1] \text{ (Schwarzschild 1996)}
\]

For example: (15) “abc *dou* bought houses.”

The possible covers of *abc* are:

- Distributive: \{a, b, c\} (abc each bought a house)
- Intermediate: \{a + b, c\} (other agent-event matching possibilities...)
- Collective: \{a + b + c\} (abc together bought a house)

- **Problems**: the distributor analysis cannot predict the following facts.


   (15) abc *dou* bought houses.

   (# w: abc all only participated in a single house-buying event.)

2. Cheng (2009): *dou* can be associated with *mei-ge-NP 'every NP', a phrase that has been distributed;

   (18) [Mei-ge ren] *dou* lai -le.

   every-CL person DOU come -ASP.

   ‘everyone *dou/*each came.’

3. Xu (2014): *dou* can co-occur with the prototypical distributor *gezi* ‘separately’.

   (19) [Tamen] *gezi* *dou* dijiao yi-fen shenqing.

   They separately DOU submit one-CL proposal

   ‘They separately *dou/*each submitted a proposal.’

4. *Dou* can be applied to a sentence that admits only a collective reading.

   (20) [abc] (dou) shi pengyou.

   abc DOU be friend

   ‘abc are (all) friends.’

3.2.2. Maximality operator analysis (Cheng & Giannakidou 2006; Xiang 2008)

- *Dou* is a maximality operator with a plural presupposition; it operates on a set that has been partitioned by covers and picks out the maximal plural individual.

- **Problems**:

1. Xiang (2008) claims that (20) takes a covered reading, where \(\text{Cov}(abc) = \{a + b, b + c, c + d, a + b + c\}\).

   But it cannot explain why readings with a cover like \(\{a + b, a + c\}\) are untenable.

2. In a non-cumulative statement, a cover doesn’t necessarily have a maximal element.

   (21) [juice and cake] *dou* cost two dollars.

   \(\text{Cov (juice and cake)} = \{\text{juice, cake, juice+cake}\}\)

\[\text{Xiang (2008: ex. 28) doesn’t consider } a + b + c \text{ as a member of Cov(abc), but it is needed so as to provide a maximal element.}\]
3.3. Predicting the \(\forall\)-quantifier use

Recall that *dou* presupposes that its prejacent has some weaker/sub-alternatives alternatives.
This presupposition derives the “distributivity requirement” and the “plurality requirement” of *dou*.

- **Deriving the “distributivity requirement”**
  Generating sub-alternatives requires **monotonicity**: the prejacent of *dou* must be monotonic wrt the position associated with *dou*.

  - In (15), the collective reading is unavailable because it doesn’t satisfy the monotonicity requirement. When the monotonicity requirement is violated, the prejacent of *dou* has no sub-alternative.

    \((15′′)\)
    
    `abc dou bought houses.'
    
    a. \(\times abc\) together bought houses. \(\neq ab\) together bought houses.
    Sub-\(\mathcal{Alt}(abc \text{ together bought houses}) = 0\)
    
    b. \(\sqrt{abc}\) each bought houses. \(\Rightarrow ab\) each bought houses.
    Sub-\(\mathcal{Alt}(abc \text{ each bought houses}) = \{x \text{ each bought-houses} : x < abc\}\)
    
    c. \(\sqrt{ Cov(abc)\text{ each bought houses}}\) \(\Rightarrow D\) each bought houses, where \(D \subset Cov(abc)\)
    Sub-\(\mathcal{Alt}(Cov(abc) \text{ each bought houses}) = \{D \text{ each bought-houses} : D \subset Cov(abc)\}\)

- **Dou** can be applied to a collective statement that satisfies the monotonicity requirement. \(^5\)
  Compare:

    \((20)\)
    
    `abc dou are friends.'
    
    a. Sub-\(\mathcal{Alt}(abc \text{ are friends}) = \{ab \text{ are friends, bc are friends, ab are friends}\}\)
    
    b. \([dou[abc \text{ are friends}]] = abc \text{ are friends, not only ab are friends, not only bc are friends, ...}\)

    (22) Tamen (*dou) zucheng -le yi-ge san-ren xiao-zu
    they **dou** make -**ASP** one-**CL** three-person small-group
    'They (*all) made up a three-person group.'

- **Deriving the “plurality requirement”**
  This requirement is illusive; it is neither necessary nor sufficient.

  - Unnecessary: **dou** can be associated with an atomic element as long as the predicate is divisive \(^6\)

    \((23)\)
    
    Yuehan ba [na-ping shei] **dou** he -le (*yi-ban).
    John **BA** that-bottle water **D**OOU drink -**ASP** one-half
    
    a. \(\sqrt{\text{‘J had that bottle of water.’} \Rightarrow \text{If } x \text{ is part of that bottle of water, J had } x.}\)
    Sub-\(\mathcal{Alt}(\text{J had that bottle of water}) = \{j \text{ had } x : x < \text{ that bottle of water}\}\)
    
    b. \(\times \text{‘J had half of that bottle of water.’} \not\Rightarrow \text{If } x \text{ is part of that bottle of water, J had half of } x.\)
    Sub-\(\mathcal{Alt}(\text{John had half of that bottle of water}) = 0\)

  - Insufficient: when applying to a monotonic collective statement, **dou** requires its associated item to denote a group containing at least 3 members. This is so because collective predicates are undefined for proper subparts of a dual-individual (i.e. atomics).

    \((24)\)
    
    `ab (*dou) are friends.'
    
    a. \([\text{are friends}] = \lambda x.\text{singular}(x) = 0.\text{be-friends}(x)\)
    
    b. Sub-\(\mathcal{Alt}(ab \text{ are friends}) = 0\)
    
    c. \([dou[abc \text{ are friends}]]\) is undefined

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\(^5\) I argue that covered readings are only available for predicates that are closed under sum: \(f(x) \land f(y) \Rightarrow \# f(x+y)\).

\(^6\) A predicate is divisive iff whenever it holds of something, it also holds of each of its proper parts: \(\forall x[P(x) \rightarrow \forall y < x[P(y)]\]
4. FCI-licenser use

4.1. Licensing conditions of Mandarin FCIs

- The English polarity item *any* is licensed as a ∀-FCI when appearing over a possibility modal, but not when it appears in an episodic statement or over a necessity modal.

(25)  
   a. *Anyone came in.*  
       Episodic statements  
   b. Anyone can come in. ≈ Everyone can come in.  
       Over possibility modals  
   c. *Anyone must come in.*  
       Over necessity modals

- In Mandarin, the ∀-FC use of a disjunction is only licensed in a pre-verbal position prior to “dou⁺◇”; but that of Mandarin bare wh-items can be licensed with a bare *dou*. 

(26) [Yuehan huozhe Mali] *dou* *(keyi)*/bixu jiao jichu hanyu.  
    John or Mary DOU can/must teach Introductory Chinese
    Intended: ‘Both John and Mary can teach Introductory Chinese.’

(27) [Shei] *(dou)* shou dao -le yaoqing.  
    whoFCI DOU get arrive -ASP invitation.  
    ‘Everyone got an invitation.’

4.2. Predicting the FCI-licenser use of *dou*

- **Fact 1:** *Dou* introduces a ∀-FC implicature.

   Explanation: Mandarin wh-items are existential indefinites; thus the plain meaning of (27) is equivalent to a disjunction. Sub-alternatives of a disjunction are the disjuncts (viz. the proper subdomain-alternatives[8]). Applying *dou* yields a ∀-FC implicature.

   (27) “Shei *dou* drink.”
      a. [sheiD got invited] = f(a) ∨ f(b)  
      b. Sub-Alt(sheiD got invited) = {f(a), f(b)}  
      c. [douD [sheiD got invited]] = [f(a) ∨ f(b)] ∧ ¬O f(a) ∧ ¬O f(b)  
          = [f(a) ∨ f(b)] ∧ [f(a) → f(b)] ∧ [f(b) → f(a)]  
          = f(a) ∧ f(b)

- **Puzzle:** Disjuncts are stronger than a disjunction, how can they be considered as sub-alternatives?

   Reply: when a disjunction is exhaustified, disjuncts are not “innocently excludable” (i.e. cannot be negated consistently): the inference resulted from negating all the disjuncts contradicts the disjunction.

   (28) (p ∨ q) ∧ ¬p ∧ ¬q = ⊥

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7 For other recent studies, see Giannakidou & Cheng (2006), Liao (2012), Cheng & Giannakidou (2013), among the others.
8 Mandarin wh-items carry a domain feature [D], which activates a set of domain (D)-alternatives and triggers obligatory exhaustification. (Chierchia 2013; Chierchia & Liao 2015)
Fact 2: The licensing of a $\forall$-FC-disjunction needs a possibility modal, while that of a bare $wh$-item doesn’t.

Explanation: disjunctions invoke SIs, while $wh$-items do not (contra Liao 2012; Chierchia & Liao 2015).

– In a non-modalized context, the $\forall$-FC implicature clearly contradicts the SI, therefore FC-disjunctions are not licensed in episodic statements. (Same as Chierchia’s 2013 analysis on English *any*.)

\[
\forall \text{-FC: } f(j) \land f(m) \quad \quad \text{SI: } \neg[f(j) \land f(m)]
\]

– In a modalized context, the SI restricts the modal base: only the worlds that satisfies the SI are accessible.

(31) [John or Mary] **dou** can teach Introductory Chinese.
    ~ We are only considered with cases where only one person will teach IC.
    ⊳ Not that both John and Mary will teach IC.
    a. SI pre-restricts the modal base $M$:
       If $f = \langle <w1, \{j\}>, <w2, \{m\}>, <w3, \{j,m\}>$, then $M = \{w1, w2\}$
       $\quad f = \text{teach IC}$
    b. Prejacent of **dou**: $\Box f(j) \lor \Box f(m)$
    c. Applying **dou** yields a $\forall$-FC implicature: $\Box f(j) \land \Box f(m)$  (True in $M$)

(32) *[John or Mary] **dou** must teach Introductory Chinese.
    a. SI pre-restricts the modal base $M$:
       If $f = \langle <w1, \{j\}>, <w2, \{m\}>, <w3, \{j,m\}>$, then $M = \{w1, w2\}$
    b. Prejacent of **dou**: $\Box f(j) \lor \Box f(m)$
    c. Applying **dou** yields a $\forall$-FC implicature: $\Box f(j) \land \Box f(m)$  (False in $M$)

4.3. Open issues

1. Why is that as an FCI-licenser, **dou** cannot be used covertly?

2. Why is that ‘which-NP’ and ‘anywhat-NP’ are bad in episodic statements? (Giannakidou & Cheng 2006)

(33) [Na-ge/Renhe -ren] **dou** keyi/bixu jinlai.
    which-$cl_{atom}$/anywhat -person **dou** can/must enter
    ‘Anyone can/must come in.’

(34) ?[Na-ge/Renhe -ren] **dou** shou dao -le yaoqing.
    which-$cl_{atom}$/anywhat -person **dou** get arrive -asp invitation
    Intended: ‘Everyone got an invitation.’
5. Scalar indicator

- As for sentences containing a scalar item, the sub-alternatives are the weaker scalar alternatives.

(35) a. Sub-Alt (it is 5 o’clock) = {it is 4 o’clock, it is 3 o’clock, ...}  
b. [dou [it is 5 o’clock]] = ‘it’s 5 o’clock, not only 4 o’clock, not only 3 o’clock, ...’

Therefore, the prejacent of dou needs to be a relatively strong scalar statement.

(36) [Da/#Shao -bufen -ren] dou lai -le.  
big/less -part -person dou come -ASP  
‘A big/#small portion of people dou came.’

- Under [lian...dou...], sub-alternatives are the ones that are more likely to be true than the prejacent.

(37) dou dou chidao -le.  
‘Even the team leader was late.’  
⇒ The team leader is less likely to be late.

a. Sub-Alt (the team leader was late) = {a team member was late}  
b. [dou [lian [the team leader was late]]]  
= ‘the team leader was late, not just that a team member was late.’

– Formally, lian triggers a scalar presupposition: the likelihood of its propositional argument is lower than that of a relevant alternative (see Bennett (1982) and Kay (1990) on even), which is identical to the presupposition of dou.

(38) lian(p) = ∃q ∈ C[p > likely p].p  
= ∃q ∈ Sub-Alt(p).p

Since now the alternatives are ranked based on likelihood instead of informativity, the pre-exhaustification effect is realized by the scalar exhaustifier just.

(39) just(q) = λw.∀q’ ∈ C[q(w) → q’ ≥ likely q]  
(every true alternative has a lower likelihood than p)

– A schematized derivation for “dou[lian(p)]”

(40) a. lian(p) = ∃q ∈ C[p > likely p].p  
b. Sub-Alt(p) = {q : q ∈ C ∧ q > likely p}  
(the set of alternatives with a higher likelihood than p)  
c. just(q) = λw.∀q’ ∈ C[q(w) → q’ ≥ likely q]  
(every relevant true alternative has a lower likelihood than p)  
d. dou[lian(p)]  
= lian(p) ∧ ∀q ∈ Sub-Alt(p)[¬ just(q)]  
= ∃q ∈ Sub-Alt(p).p ∧ ∀q ∈ Sub-Alt(p)[¬ just(q)]  
= λw.∃p’ ∈ C[p > likely p].p(w) ∧ ∀q ∈ C[q > likely p] → ∃q’ ∈ C[q(w) ∧ q’ < likely q]  
i. Presupposition: there is an alternative of p with a higher likelihood than p  
(i.e. p has a sub-alternative.)  
ii. Assertion: p is true; and for every alternative q with a higher likelihood than p, there is a true alternative with a lower likelihood than q.  
(i.e. p is true; and for every sub-alternative q, just(q) is false.)

– The minimizer-licenser use of dou can be derived in exactly the same way (details are omitted).
6. Conclusions

- I have proposed that *dou* is a presuppositional exhaustifier that (i) operates on sub-alternatives and (ii) has a pre-exhaustification effect.

  - In general:

    (41)  
    \[ \textbf{dou} (p) = \exists q \in \text{Sub-Alt}(p) \land \forall q \in \text{Sub-Alt}(p)[\neg O(q)] \]
    i. Presupposition: the prejacent has some sub-alternatives
    ii. Assertion: the prejacent is true, the exhaustification of each sub-alternative is false.

    - In a *[lian ... dou]* construction:

      (42)  
      \[ \textbf{dou} (p) = \textbf{lian} (p) \land \forall q \in \text{Sub-Alt}(p)[\neg \textbf{just} (q)] \]
      \[ = \exists q \in \text{Sub-Alt}(p) \land \forall q \in \text{Sub-Alt}(p)[\neg \textbf{just} (q)] \]
      b. Sub-\text{Alt} (p) = \text{Alt} (p) \setminus \text{IE-excl} (p) \setminus \{p\}
      (the set of alternatives excluding the IE-alternatives and the prejacent itself)

References


