Mandarin Particle DOU: A Pre-exhaustification Exhaustifier

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Abstract This paper provides a uniform semantics to capture various functions of Mandarin particle dou, including the quantifier use, FCI-licenser use, and scalar marker use. I argue that dou is a presuppositional exhaustifier that operates on sub-alternatives and has a pre-exhaustification effect.

Keywords Dou · Exhaustification · Quantification · Free choice · Scalar · Alternative Semantics

1 Introduction
The Mandarin particle dou has various uses. Descriptively speaking, it can be used as a universal quantifier, a free choice item (FCI)-licenser, a scalar marker, and so on.

First, in a basic declarative sentence, the particle dou, similar to English all, is associated with a preceding nominal expression and universally quantifies over the subparts of this expression, as exemplified in (1). Here and throughout the paper, I use a [square bracket] to mark the item associated with dou.

(1)  
  a. [Tamen] dou dao -le.  
      they DOU arrive -ASP  
      ‘They all arrived.’
      they DOU BA those question answer correct -ASP  
      ‘They all correctly answered these questions.’
      they BA those question DOU answer correct -ASP  
      ‘They correctly answered all of these questions.’
Moreover, under the quantifier use, *dou* brings up three more semantic consequences in addition to universal quantification, namely a “maximality requirement”, a “distributivity requirement”, and a “plurality requirement”. The “maximality requirement” means that *dou* forces the predicate denoted by the remnant VP to predicate on the maximal element in the extension of the associated item (Xiang 2008). For instance, imagine a discourse that a large group of children, with one or two exceptions, went to the park. Then (2) can be judged as true only when *dou* is absent.

(2)  

[Haizimen] (#dou) qu -le gongyuan.  
children DOU go -PERF park  
‘The children (#all) went to the park.’

The “distributivity requirement” says that if a sentence admits both collective and distributive/cumulative readings, applying *dou* over this sentence blocks the collective reading (Lin 1998). For instance, (3a) is infelicitous if John and Mary married each other, and (3b) is infelicitous if all the considered individuals only participated in one house-buying event.

(3)  

a.  

[Yuehan he Mali] dou jiehun -le.  
John and Mary DOU get-married -ASP  
‘John and Mary each got married.’

b.  

[Tamen] dou mai -le fangzi.  
they DOU buy -PERF house  
‘They all bought houses.’ (# collective)

The “plurality requirement” says that the item associated with *dou* must take a non-atomic interpretation. If the prejacent sentence of *dou* has no overt non-atomic term, *dou* needs to be associated with a covert non-atomic item. For example in (4), since the spelled-out part of prejacent sentence has no non-singular term, *dou* is associated with a covert term such as *zhe-ji-ci* ‘these times’.

(4)  

Yuehan [(zhe-ji-ci)] dou qu de Beijing.  
John this-several-time DOU go DE Beijing  
‘For all of these times, the place that John went to was Beijing.’

Second, as is well-known, *dou* can license a pre-verbal *wh*-item as a
universal FCI, as exemplified in (5). Moreover, I observe that *dou* in company with a possibility modal can license the universal FCI use of a pre-verbal disjunction, as shown in (6). In particular, if the possibility modal *keyi* ‘can’ is dropped or replaced with a necessity modal *bixu* ‘must’, the use of *dou* makes the sentence ungrammatical.

(5) a. [Shui] (dou) he -guo jiu.
    who DOU drink -EXP alcohol
    ‘Anyone/everyone has had alcohol.’

   b. [Na-ge nanhai] *(dou) he -guo hejiu.
      which-CL boy DOU drink -EXP alcohol
      ‘Any/Every boy has had alcohol.’

(6) a. [Yuehan huozhe Mali] (dou) keyi jiao hanyu.
       John or Mary DOU can teach Chinese
       Without *dou*: ‘Either John or Mary can teach Chinese.’
       With *dou*: ‘Both John and Mary can teach Chinese.’

   b. [Yuehan huozhe Mali] *(dou) jiao hanyu.
      John or Mary DOU teach Chinese

   c. [Yuehan huozhe Mali] *(dou) bixu jiao hanyu.
      John or Mary DOU must teach Chinese

Third, when associated with a scalar item, *dou* implies that the prejacent proposition ranks relatively high in the considered scale. When *dou* takes this use, its associated item can stay in-situ but must be focus-marked. Like in (7a), *dou* is associated with the numeral phrase *wu dian* ‘five o’clock’, and the alternatives are ranked in chronological order.

(7) a. Dou [WU\textsubscript{F}-dian] -le.
    DOU five-o’clock -ASP
    ‘It is five o’clock.’ \(\rightsquigarrow\) Being five o’clock is a bit late.

   b. Ta dou lai -guo zher [LIANG\textsubscript{F}-ci] -le.
      he DOU come -EXP here two-time -ASP.
      ‘He has been here twice.’ \(\rightsquigarrow\) Being here twice is a lot.

The [\textit{lian} Foc *dou* ...] construction is a special case where *dou* functions as a scalar marker. A sentence taking a [\textit{lian} Foc *dou* ...] construction has an ‘even’-like interpretation; it implicates that the prejacent proposition is
less likely to be true than (most of) the contextually relevant alternatives.

(8) (Lian) [duizhang]_F dou chi dao -le.
    LIAN team-leader DOU late arrive -ASP
    ‘Even [the team leader]_F arrived late.’

In particular, ‘one-CL-NP’ can be licensed as a minimizer at the focus position of the [lian Foc dou NEG ...] construction, as shown in (9a). Notice that the post-dou negation is not always needed, as shown in (9b).

(9) a. Yuehan (lian) [Y1F-ge ren] *(dou) *(mei) qing.
    John LIAN one-CL person DOU NEG invite
    ‘John didn’t invite even one person.’

b. Yuehan (lian) [Y1F-fen qian] *(dou) (mei) yao.
    John LIAN one-cent money DOU NEG request
    Without negation: ‘John doesn’t want any money.’
    With negation: ‘Even if it is just one cent, John wants it.’

In case that a sentence has multiple items that are eligible to be associated with dou, the function of dou and the association relation can be disambiguated by stress. Compare, in (10a), the prejacent of dou has no stressed item, dou functions as a quantifier and is associated with the preceding plural term tamen ‘they’; while in (10b) and (10c), dou functions as a scalar marker and is associated with the stressed item.

    they DOU/DOU come -EXP two-time -ASP
    ‘They ALL have been here twice.’

    they DOU come -EXP two-time -ASP
    ‘They’ve been here twice.’ \(\rightsquigarrow\) Being here twice is a lot.

c. (Lian) [TAMEN]_F dou lai -guo liang-ci -le.
    LIAN they DOU come -EXP two-time -ASP
    ‘Even THEY have been here twice.’

The goal of this paper is to provide a uniform semantics of dou to account for its seemingly diverse functions. I propose that dou is a special exhaustifier that operates on sub-alternatives and has a pre-exhaustification
effect. The basic idea can be sloppily described as follows. Assume that a *dou*-sentence is of the form “*dou*(x, P)” where x and P correspond to the associated item and the remnant VP, respectively. The basic meaning of *dou*(x, P) is *P*(x) and not only *P*(x′), where x′ can be a proper subpart of x, a weaker scale-mate of x, and so on. For example, “[A and B] dou came” means that A and B came, not only A came, and not only B came; “it’s dou [five] o’clock” means that it’s 5 o’clock, not just 4 o’clock, not just 3 o’clock,....

The rest of this paper is organized as follows. Section 2 will review two representative theories on the semantics of *dou*, namely the distributor approach (1998) and the maximality operator approach (Giannakidou & Cheng 2006; Xiang 2008). Section 3 will define *dou* as a special exhaustifier and compare it with the canonical exhaustifier only. Section 4 will discuss the universal quantifier use of *dou*. I will show that the so-called “distributivity requirement” and “plurality requirement” are both illusions, and that the facts that usually thought to be related to these two requirements result from the additive presupposition of *dou*. Section 5 and 6 will be centered on the FCI-licenser use and the scalar marker use, respectively.

2 Previous studies
There are numerous studies on the syntax and semantics of *dou*. Traditional grammarians treat *dou* as an adverb with universal quantification power (Lee 1986; Cheng 1995; a.o.). Portner (2002) analyzes the scalar marker use of *dou* in a way similar to the inherent scalar semantics of the English focus sensitive particle *even*. Hole (2004) treats *dou* as a universal quantifier over the domain of alternatives. This section will review two representative studies on the semantics of *dou*, one is the distributor approach by Lin (1996), and the other is the maximality operator approach along the lines of Giannakidou & Cheng (2006) and Xiang (2008).

2.1 The distributor approach
Lin (1996, 1998) provides the first extensive treatment of the semantics of *dou*. He proposes that *dou* is an overt counterpart of the generalized distributor D in the sense of Schwarzschild (1996). Unlike the regular distributor *each* which distributes over an atomic domain, the generalized
$D$-operator distributes over the cover of the nominal phrase associated with *dou*. A cover of an individual $x$ is a set of subparts of $x$, as defined in (11) and exemplified in (12). Its value is determined by the linguistic and non-linguistic context.

(11) $Cov$ is a cover of $x$ iff (i) $Cov$ is a set of subparts of $x$; and (ii) every subpart of $x$ belongs to some member in $Cov$.

(12) Possible covers of $abc$ and corresponding readings:

$$\begin{align*}
\{a, b, c\} & \quad \text{Distributive} \\
\{a \oplus b, c\} \\
\{a \oplus b, b \oplus c\} \\
\cdots \\
\{a \oplus b \oplus c\} & \quad \text{Collective}
\end{align*}$$

The semantics of *dou* is thus schematized as follows.

(13) $\llbracket \text{dou} \rrbracket (P, x)$ is true iff $x \in D(Cov)(P)$ iff $\forall y \in Cov[P(y) = 1]$, where $Cov$ is a cover of $x$.

The distributor approach only considers the quantifier use of *dou*. It is unclear how one can extend it to the other uses such as the FCI-licenser use and the scalar marker use. Moreover, even for the quantifier use, this approach faces the following challenges.

First, *dou* evokes a distributivity requirement, but the generalized $D$-distributor does not. For instance, as seen in (3b) and repeated below, the presence of *dou* eliminates the collective reading of the prejacent sentence. As Xiang (2008) argues, if *dou* were a generalized distributor, it should be compatible with a single cover reading (viz. the collective reading): there can be a discourse under which the cover of *tamen* ‘they’ denotes a singleton set like $\{\{a \oplus b \oplus c\}\}$; distributing over this singleton set yields a collective reading.

(14) $\llbracket \text{Tamen} \rrbracket$ *dou* mai -le fangzi.

they *dou* buy -PERF house

‘They *dou* bought houses.’ (# collective)
Second, unlike English distributors like *each* and *all*, *dou* can be associated with a distributive expression such as NP-*gezi ‘NP each’.*

(15)  
(a) They each (*each/*all) has some advantages.  
(b) [Tamen *gezi*] *dou* you yixie youdian.  
They each *dou* have some advantages  
‘They each *dou* has some advantages.’

### 2.2 The maximality operator analysis

Another popular approach, initiated by Giannakidou & Cheng (2006) and extended by Xiang (2008), is to treat *dou* as a presuppositional maximality operator. Briefly speaking, this approach proposes that *dou* operates on a non-singleton cover of the associated item, returns the maximal plural element in this cover, and presupposes the existence of this maximal plural element. I schematize this idea as follows.

(16)  
Let Cov be a cover of *x*, then \( [dou](x) \)  
\[= |Cov| > 1 \land \exists y \in Cov[\neg \text{Atom}(y) \land \forall z \in Cov[z \leq y]]. \]

\( [dou](x) \) is defined only if the cover of *x* is non-singleton and has a unique non-atomic maximal element; when defined, the reference of \( [dou](x) \) is this maximal element.)

This approach is close to the standard treatment of the definite determiner *the* (Sharvy 1980; Link 1983): *the* picks out the unique maximal

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1Champollion (to appear) argues that *all* is a distributor that distributes down to subgroups, while that *each* distributes all the way down to atoms.

2Similar arguments have been reached in previous studies (Cheng 2009; a.o.), but they are mostly based on the fact that *dou* can be associated with the distributive quantificational phrase *mei-*CL-NP ‘every NP’, as exemplified in (i). This fact, however, cannot knock down the distributor approach for the quantifier use of *dou*: observe in (i) that stress falls on the distributive phrase *mei-*CL-NP, not the particle *dou*; therefore here *dou* functions as a scalar marker, rather than a quantifier.

(i)  
(a) [MEI-*ge ren] *dou* you youdian.  
every-CL person *dou* have advantage  
‘Everyone *dou* has some advantages.’
(b) ??[Mei-*ge ren] *DOU* you youdian.  
every-CL person *DOU* have advantage
element in the extension of its NP complement and presupposes the existence of this maximal element.

This approach is superior to the distributor approach in two respects: first, it captures the maximality requirement; and second, it can be extended to the scalar use of *dou* (see details in Xiang 2008). Nevertheless, this approach still faces many conceptual or empirical problems. First, the plurality requirement comes as a stipulation on the presupposition of *dou*: *dou* presupposes that the selected maximal element is non-atomic. It is unclear why is that so; the definite article *the* does not trigger such a plural presupposition. Moreover, as we will see in section 4.3, this plural presupposition is neither sufficient nor necessary in dealing with the relevant facts. Second, this approach predicts no distributivity effect at all. Under this approach, “[X] *dou* did f” only asserts that *the maximal element in the cover of X did f*, not that *each element in the cover of X did f*. For instance in (14), if the cover of *tamen* ‘they’ is \{a ⊕ b, a ⊕ b ⊕ c\}, the predicted assertion is simply *that a ⊕ b ⊕ c bought houses*, which says nothing as to whether a ⊕ b bought houses.

3 Defining *dou* as a special exhaustifier

This section will start with the semantics of the canonical exhaustifier *only*, and then define Mandarin particle *dou* as a special exhaustifier: *dou* is a pre-exhaustification exhaustifier that operates on sub-alternatives.

3.1 Canonical exhaustifier *only*

The exclusive particle *only* is a canonical exhaustifier. Using Alternative Semantics for focus (Rooth 1985, 1992, 1996), we can summarize the standard treatment of the semantics of *only* into two parts. First, a focused element is associated with a set of focus alternatives. This alternative set grows point-wise (Hamblin 1973), as recursively defined in (17), adopted from Chierchia (2013: 138).

\[(17) \quad \begin{align*}
\text{a. Basic Clause: for any lexical entry } \alpha, \text{ } &\text{Alt(}\alpha\text{)} = \\
&\{\llbracket \alpha \rrbracket\} \text{ if } \alpha \text{ is lexical and does not belong to a scale;} \\
&\{\llbracket \alpha_1 \rrbracket, \ldots, \llbracket \alpha_n \rrbracket\} \text{ if } \alpha \text{ is lexical and part of a scale } \\
&\langle \llbracket \alpha_1 \rrbracket, \ldots, \llbracket \alpha_n \rrbracket \rangle.
\end{align*}
\]

\[\text{b. Recursive Clause: } \text{Alt}(\beta(\alpha)) = \{b(\alpha) : b \in \text{Alt}(\beta), a \in \text{Alt}(\alpha)\}\]
Second, the exclusive particle *only* presupposes the truth of its prejacent proposition (Horn 1969) and asserts an exhaustivity inference. This exhaustivity inference negates all the focus alternatives that are excludable. An alternative is excludable as long as it is not entailed by the prejacent.\(^3\)

\[(18)\]
\[
a. \quad [\text{only}] (p) = p \land \forall q \in \text{Excl}(p)[\neg q] \quad \text{(To be revised)} \\
b. \quad \text{Excl}(p) = \{q : q \in \text{Alt}(p) \land p \not\subseteq q\}
\]

In addition to the prejacent presupposition, I argue that *only* also triggers an additive presupposition, namely that the prejacent has at least one excludable alternative. In (19), *only* has a restricted exhaustification domain, namely \{I will invite John, I will invite Mary, I will invite John and Mary\}. Contrary to the case of (19a), (19b) is infelicitous because the prejacent I will invite both John and Mary is the strongest one among the alternatives and has no excludable alternative. As Martin Hackl (p.c.) points out, the additive presupposition of *only* can be reduced to a more general economy condition that an overt operator cannot be applied vacuously. For sake of comparison, observe that (19c) is felicitous, which is because covert exhaustification is free from the economy condition and does not trigger an additive presupposition.

\[(19)\] Which of John and Mary will you invite?  
\[
a. \quad \text{Only JOHN}_F, \ (\text{not Mary/ not both}). \\
b. \quad \# \text{ Only BOTH}_F. \\
c. \quad \text{BOTH}_F.
\]

In sum, I schematize the semantics of *only* as follows: it presupposes the truth of its prejacent and the existence of an excludable alternative; it negates each excludable alternative.

\[(20)\]  
\[
a. \quad \text{Prejacent presupposition: } p \\
b. \quad \text{Additive presupposition: } \exists q \in \text{Excl}(p) \\
c. \quad \text{Assertion: } \forall q \in \text{Excl}(p)[\neg q]
\]

\(^3\)For simplicity, here and throughout the paper, propositional letters like \(p\) are sloppily used for both syntactic expressions and semantic values.
3.2 Special exhaustifier *dou*

I define *dou* as a pre-exhaustification exhaustifier over sub-alternatives, as schematized in (21): it presupposes an additive inference; it affirms the prejacent and negates the exhaustification of each sub-alternative.

\[(21) \quad \llbracket \textit{dou} \rrbracket(p) = \exists q \in \text{Sub}(p). p \land \forall q \in \text{Sub}(p)[\neg \textit{O}(q)]\]

The additive presupposition is motivated by the economy condition, just like what we saw with the canonical exhaustifier *only*. The exhaustivity inference asserted by *dou* differs from that asserted by *only* in two respects. First, *only* operates on excludable alternatives, but *dou* operates on sub-alternatives. For now we can understand sub-alternatives as weaker alternatives, or say, the alternatives that are not excludable and distinct from the prejacent. A revision will be made in section 5.

\[(22) \quad \text{Sub}(p) = \{ q : q \in \text{Alt}(p) \land p \subset q \} = \text{Alt}(p) - \text{Excl}(p) - \{ p \} \]

(To be revised)

Second, *dou* has a pre-exhaustification effect: it negates the “exhaustification” of each sub-alternative. The pre-exhaustification effect is realized by applying an *O*-operator to each sub-alternative.\(^4\) The *O*-operator is a covert counterpart of the exclusive particle *only*, coined by the grammatical view of scalar implicatures (Fox 2007; Chierchia et al. 2013; Fox & Spector to appear; a.o.). This *O*-operator affirms the prejacent and negates all the excludable alternatives of the prejacent.

\[(23) \quad \textit{O}(p) = p \land \forall q \in \text{Excl}(p)[\neg q] \quad \text{(Chierchia et al. 2013)}\]

Consider (24) for a simple illustration of the present definition. The prejacent and the sub-alternatives are schematized in (24a) and (24b), respectively. Exercising *dou* affirms the prejacent and negates the exhaustification of each sub-alternative, as in (24c), yielding the inference *that John and Mary arrived, not only John arrived, and not only Mary arrived*. The exhaustivity inference (underlined above), while is entailed by the

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\(^4\)In section 6, we will see other options to derive the pre-exhaustification effect. For instance, when *dou* is used as a scalar marker, the pre-exhaustification effect is realized by applying a scalar exhaustifier (≈ *just*) to the sub-alternatives.
prejacent and attributes nothing new to the truth conditions, gives rise to an emphatic effect.

(24) [John and Mary] **dou** arrived.

a. \( p = A(j \oplus m) \)

b. \( \text{Sub}(p) = \{A(j), A(m)\} \)

c. \( \langle\text{dou}\rangle(p) = A(j \oplus m) \land \neg O[A(j)] \land \neg O[A(m)] \)

### 4 The universal quantifier use

Recall that **dou** evokes three requirements when used as a universal quantifier: (i) the “maximality requirement”, namely that **dou** forces maximality with respect to the domain denoted by the associated item; (ii) the “distributivity requirement”, namely that the prejacent sentence cannot take a collective reading; (iii) the “plurality requirement”, namely that the item associated with **dou** must take a non-atomic interpretation. In this section, I will show that the maximality requirement is a simple logical consequence of **dou**’s assertion, and argue that the other two requirements are illusions. Moreover, I will argue that all the facts that are thought to result from the latter two requirements actually result from the additive presupposition of **dou**.

#### 4.1 Explaining the “maximality requirement”

The maximality requirement comes from the assertion of **dou**: **dou** asserts that, for each sub-alternative of the prejacent, its exhaustification is false. For instance in (2), repeated below, applying **dou** yields the inference that *it is false that only a subgroup of children went to the park*; therefore in presence of **dou**, (25) is true iff all the children went to the park.

(25) [Haizimen] (*#dou*) **qu-le** gongyuan.

children **DOU** go -PERF park

‘The children (*#all*) went to the park.’

#### 4.2 Explaining the “distributivity requirement”

To generate sub-alternatives and satisfy the additive presupposition of **dou**, the prejacent of **dou** needs to be monotonic with respect to the position associated with **dou**, which therefore gives rise to the “distributivity
requirement”. For instance, the sentence (26) rejects a collective reading because under this reading the prejacent proposition of \textit{dou} is non-monotonic with respect to the subject position and hence has no sub-alternative, as shown in (26a). In contrast, when taking a distributive reading or a cumulative reading, the prejacent of \textit{dou} is monotonic with respect to the subject position and does generate some sub-alternatives, as shown in (26b) and (26c).

(26) \[abc\] \textbf{dou} bought houses.

\begin{enumerate}
\item \textit{Collective} \times
\begin{enumerate}
\item \(abc\) together BH. \(\not\rightarrow ab\) together BH.
\item \(\text{Sub}(abc\ \text{together BH})=\emptyset\)
\end{enumerate}
\item \textit{Distributive} \checkmark
\begin{enumerate}
\item \(abc\) each BH. \(\rightarrow ab\) each BH.
\item \(\text{Sub}(\text{each}(x)(BH)) = \{\text{each}(x)(BH): x < abc\}\)
\end{enumerate}
\item \textit{Cumulative} \checkmark
\begin{enumerate}
\item members of \(\text{Cov}_{abc}\) each BH.
\(\rightarrow\) members of \(X\) each BH, where \(X \subset \text{Cov}_{abc}\)
\item \(\text{Sub}(D(\text{Cov}_{abc})(BH)) = \{D(X)(BH): X \subset \text{Cov}_{abc}\}\)
\end{enumerate}
\end{enumerate}

Hence, \textit{dou} itself is not a distributor; but in certain cases, the additive presupposition of \textit{dou} evokes the use of a distributor. We can now easily explain why \textit{dou} can be associated with a distributive expression NP-\textit{gezi} ‘NP-each’: the presence of the distributor \textit{gezi} ‘each’ is actually required for the sake of satisfying the additive presupposition of \textit{dou}; if \textit{gezi} is not overtly used, a covert distributor is still present in the logical form.

(27) \[\text{Tamen gezi}\] \textbf{dou you yixie youdian}.

They each \textbf{dou} have some advantage

‘They each \textbf{dou} has some advantages.’

Moreover, \textit{dou} can be applied to a collective statement as long as this statement satisfies the monotonicity requirement. For instance, \textit{dou} is compatible with monotonic collective predicates (e.g., \textit{shi pengyou} ‘be friends’, \textit{jihe} ‘gather’, \textit{jianmian} ‘meet’), as shown in (28). Consider (28a)

\footnote{\(\text{Cov}_{abc}\) in (26c) stands for a contextually determined variable that is a cover of \(abc\).}
for instance. Let *tamen* ‘they’ denote three individuals *abc*. The set of sub-alternative sets is \{*ab are friends, bc are friends, ac are friends*\}; applying *dou* yields the following inference: *abc are friends, not only ab are friends, not only bc are friends, and not only ac are friends*.

(28)  
\begin{enumerate}
  \item [a.] \(\text{[Tamen]}\) *dou* shi pengyou.  
  \hspace{1cm} \text{they DOU be friends}  
  \hspace{1cm} ‘They are (all) friends.’
  
  \item [b.] \(\text{[Tamen]}\) *dou* zai dating jihe -le.  
  \hspace{1cm} \text{they DOU at hallway gather -ASP}  
  \hspace{1cm} ‘They (all) gathered in the hallway.’
  
  \item [c.] \(\text{[Tamen]}\) *dou* jian-guo-mian -le.  
  \hspace{1cm} \text{they DOU see-EXP-face -ASP}  
  \hspace{1cm} ‘They (all) have met.’
\end{enumerate}

Compare, *dou* cannot be applied to a collective statement that does not satisfy the monotonicity requirement, as shown in (29).

(29)  
\(\text{[Tamen]}\) (*dou*) zucheng -le lia er-ren-zu.  
\hspace{1cm} \text{they DOU form -ASP two two-person-group}  
\hspace{1cm} ‘They (*all) formed two pairs.’

Note to distinguish the case in (29) from the following ones, where the prejacent sentences actually admit non-collective readings and thus satisfy the monotonicity requirement.

(30)  
\(\text{[Tamen]}\) *dou* zucheng -le er-ren-zu.  
\hspace{1cm} \text{they DOU form -ASP two two-person-group}  
\hspace{1cm} ‘They all formed pairs.’

(31)  
\(\text{[Women he tamen]}\) *dou* zucheng -le lia er-ren-zu.  
\hspace{1cm} \text{we and they DOU form -ASP two two-person-group}  
\hspace{1cm} ‘We formed two pairs, and they formed two pairs.’

In (30), the extension of the predicate ‘formed pairs’ (FP) is closed under sum, just like any plural terms: \(\text{FP}(a \oplus b) \land \text{FP}(c \oplus d) \Rightarrow \text{FP}(a \oplus b \oplus c \oplus d)\) (see Kratzer (2008) for general discussions on plural verbal predicates); hence the prejacent sentence admits a covered/cumulative reading. In (31), although the predicate ‘formed two pairs’ (F2P) is non-monotonic, the
subject ‘we and they’ can be interpreted as a higher-order conjunction, each conjunct of which yields a sub-alternative. A schematized derivation for the sub-alternatives in (31) is given in (32).

\[
\begin{align*}
(32) & \quad a. \quad \left[\text{we and they}\right] = \lambda P_{est} \cdot \lambda w. P_w(we) \land P_w(they) \\
& \quad b. \quad \left[\text{we and they } F2P\right] = \lambda w. F2P_w(we) \land F2P_w(they) \\
& \quad c. \quad \text{Sub}(\text{we and they } F2P) = \{F2P(we), F2P(they)\}
\end{align*}
\]

### 4.3 Explaining the “plurality requirement”

I argue that the so-called “plurality requirement ” of dou is illusive, and that the related facts all result from the additive presupposition of dou.

First, the plurality requirement is unnecessary: dou can be associated with an atomic as long as the remnant VP denotes a divisive predicate.

\[
(33) \quad \text{\(P\) is divisive iff } \forall x [P(x) \rightarrow \forall y < x [P(y)]]
\]

\((A \text{ predicate is divisive iff whenever it holds of something, it also holds of each of its proper parts.})\)

For instance in (34a), the associated item ‘that apple’ takes only an atomic interpretation; with a divisive predicate \(\lambda x. \text{John ate } x\), the prejacent sentence of dou has sub-alternatives, as schematized in (35a), which supports the presupposition of dou. Compare, in (34b), the predicate \(\lambda x. \text{John ate half of } x\) is not divisive and is incompatible with the use of dou.

\[
(34) \quad a. \quad \text{Yuehan ba [na-ge pingguo] (dou) chi -le.} \\
\quad \text{John \ BA that-CL apple DOU eat -PERF} \\
\quad \text{‘John ate that apple.’} \\
\quad b. \quad \text{Yuehan ba [na-ge pingguo] (*dou) chi -le yi-ban.} \\
\quad \text{John \ BA that-CL apple DOU eat -PERF one-half} \\
\quad \text{Intended: ‘John ate half of that apple.’}
\]

\[
(35) \quad a. \quad \text{‘J ate that apple.’} \Rightarrow \text{‘J ate } x.\text{’ (}x < \text{ that apple)} \\
\quad \text{Sub (J ate that apple) = \{J had } x: x < \text{ that apple\}} \\
\quad b. \quad \text{‘J ate half of that apple.’} \nRightarrow \text{‘J ate half of } x.\text{’ (}x < \text{ that apple)} \\
\quad \text{Sub (John ate half of that apple) = \{\}}
\]

Second, the plurality requirement is insufficient. When applied to a monotonic collective statement, dou requires its associated item to de-
note a group consisting of at least three members, as exemplified in (36).

(36)  \[
[Tamen -sa/*-lia] \quad \textbf{dou} \, \text{shi pengyou.}
\]
they \quad -three/-two \textbf{dou} be friends

‘They three/*two are all friends.’

This fact is also predicted by the additive presupposition. As schematized in (37), the proper subparts of an dual-individual denotes an atomic individual, which however is undefined for the collective predicate ‘be friends’. Hence, if the item associated with \textbf{dou} in (36) denotes only a dual-individual, the prejacent of \textbf{dou} has no sub-alternative, which therefore leaves the presupposition of \textbf{dou} unsatisfied.

(37)  \[
\textit{[ab] (*dou)} \text{ are friends}.
\]
\begin{itemize}
\item a. \quad \text{[[\textit{be friends}]]} = \lambda x.\text{Atom}(x) = 0.\text{be-friends}(x)
\item b. \quad \text{Sub}(\textit{ab are friends}) = \emptyset
\end{itemize}

5 The universal FCI-licenser use

\textbf{Dou} can license the universal FC use of polarity items, \textit{wh}-items, and pre-verbal disjunctions. In this section, I argue that the asserted component of \textbf{dou} converts a disjunctive/existential statement into a conjunctive/universal statement, giving rise to an FC inference. I will also explain why the licensing of universal FCIs requires the presence of \textbf{dou}, and why the licensing of a pre-verbal disjunction as a universal FCI exhibits the effect of modal obviation.

5.1 Licensing conditions of Mandarin FCIs

In Mandarin, the licensing of a universal FCI requires the presence of \textbf{dou}. For instance in (38), the bare \textit{wh}-word \textit{shei} ‘who’ is licensed as a universal FCI only when it precedes \textbf{dou}.

(38)  \[
[\textit{Shei} * (\textbf{dou}) jiao \quad \text{-guo jichu hanyu.}
\]
who \quad \textbf{dou} \text{ teach -exp intro Chinese.}

‘Everyone has taught Intro Chinese.’

To license the universal FC use of a disjunction, \textbf{dou} must be present and followed by a possibility modal, as shown in (39) and (40). This requirement is also observed with English emphatic item \textit{any}: as shown in (41),
any is licensed as a universal FCI when it precedes a possibility modal, but not licensed when it appears in an episodic statement or before a necessity modal.

(39)  [Yuehan huozhe Mali] **dou** keyi/*bixu jiao jichu hanyu.  
      John or Mary **dou** can/must teach intro Chinese  
      ‘Both John and Mary can teach Intro Chinese.’

(40)  [Yuehan huozhe Mali] (*dou) jiao -guo jichu hanyu.  
      John or Mary **dou** teach **-exp intro Chinese**  
      Intended: ‘Both Johan and Mary have taught Intro Chinese.’

(41)  a. *Anyone came in.  
      b. Anyone can/*must come in.

The licensing conditions of na-cl-NP ‘which-NP’ and renhe-NP ‘any-NP’ are less clear. Giannakidou & Cheng (2006) claim that the universal FC uses of these items are only licensed in a pre-dou+◊ position; their judgements are illustrated in (42). Nevertheless, it is difficult to justice the data because judgements on (42) vary greatly among native speakers.

(42)  a. [Na-ge/Renhe **-ren**] **dou** keyi/?bixu jinlai.  
      which-cl/anywhat -person **dou** can/must enter  
      Intended: ‘Everyone can/must come in.’  

      b. ![Expression] [Na-ge/Renhe **-ren**] **dou** shou dao -le yaoqing.  
      which-cl/anywhat -person **dou** get arrive -asp invitation  
      Intended: ‘Everyone got an invitation.’

Despite the noise in the judgments, the licensing conditions of universal FCIs in Mandarin can be summarized as follows. First, every universal FCI requires the presence of **dou**. Second, every universal FCI can be licensed before **dou**+◊. Third, in absence of the possibility modal, ‘which’/‘any’-NP is less likely to be licensed than bare wh-words, but more likely to be licensed than disjunctions. For other recent studies, see Liao (2011), Cheng & Giannakidou (2013), and Chierchia & Liao (2015).

5.2 Predicting the universal FC inferences
Wh-items are generally considered as existential indefinites; thus in (38), repeated below, the prejacent sentence of **dou** is a disjunction, and the
sub-alternatives are the disjuncts. Applying *dou* affirms the prejacent and negates the exhaustification of each disjunct, yielding a universal FC inference. In a word, *dou* turns a disjunction into a conjunction.⁶

(43) [Shei] *(dou)* has taught Intro Chinese.

a. \( p = f(a) \lor f(b) \)
b. \( \text{Sub}(p) = \{f(a), f(b)\} \)
c. \[\llbracket \text{dou} \rrbracket (p)\]
   \[= [f(a) \lor f(b)] \land \neg Of(a) \land \neg Of(b)\]
   \[= [f(a) \lor f(b)] \land [f(a) \rightarrow f(b)] \land [f(b) \rightarrow f(a)]\]
   \[= f(a) \lor f(b) \land [f(a) \leftrightarrow f(b)]\]
   \[= f(a) \land f(b)\]

What makes the use of *dou* mandatory in (38)? Following Liao (2011) and Chierchia & Liao (2015), I assume that the sub-alternatives associated with a Mandarin wh-word are obligatorily activated in a non-interrogative sentence and must be used up via exercising a c-commanding exhaustifier. If *dou* is absent, these sub-alternatives would be used by a basic exhaustifier (23), repeated in (44a), which has no pre-exhaustification effect. As schematized in (44b), a basic \( O \)-operator affirms the prejacent disjunction and negates both disjuncts, yielding a contradiction.

(44) a. \( O(p) = p \land \forall q \in \text{Excl}(p)[\neg q] \) (Chierchia et al. 2013)
b. \( O(f(a) \lor f(b)) = [f(a) \lor f(b)] \land \neg f(a) \land \neg f(b) = \bot\)

Now, a problem arises as to the definition of sub-alternatives: in section 3, I defined sub-alternatives as weaker alternatives, namely alternatives that are not excludable and distinct from the prejacent; but in (43) the disjuncts are semantically stronger than the disjunction.

This problem can be solved by a simple move from excludability to innocent excludability, a notion proposed by Fox (2007): an alternative is innocently excludable iff the inference of affirming the prejacent and negating this alternative is consistent with negating any excludable alternative. Thus, we can say that sub-alternatives are alternatives that are

---

⁶Readers who are familiar with the grammatical view of FC implicatures might find that *dou* is very close to the operation of recursive exhaustifications proposed by Fox (2007) and the pre-exhaustification \( O_{exh} \)-operator used by Chierchia (2006, 2013).
not innocently excludable and distinct from the prejacent.

(45) a. **Excludable alternatives**

\[ \text{Excl}(p) = \{q : q \in \text{Alt}(p) \land p \not\subseteq q\} \]

(the set of alternatives that are entailed by the prejacent.)

b. **Innocently excludable alternatives** (Fox 2007)

\[ \text{IExcl}(p) = \{q : q \in \text{Alt}(p) \land \neg \exists q' \in \text{Excl}(p)\{p \land \neg q \rightarrow q'\}\} \]

({\{q: affirming p and negating q does not entail any excludable alternatives\}})

c. **Sub-alternatives**

\[ \text{Sub}(p) = \text{Alt}(p) - \text{IExcl}(p) - \{p\} \quad \text{(final version)} \]

(the set of alternatives excluding the innocently excludable alternatives and the prejacent)

In (43), the disjuncts are not innocently excludable to the disjunction: as schematized below, affirming the disjunction and negating one of the disjuncts entail the other disjunct; in other words, affirming the disjunction and negating both disjuncts would yield a contradiction. Hence, the sub-alternatives of a disjunction are the disjuncts.

(46) \[ [(f(a) \lor f(b)) \land \neg f(a)] \Rightarrow f(b) \]

A full definition of **dou** is schematized as follows.

(47) a. \[ \text{⟦dou⟧}(p) = \exists q \in \text{Sub}(p).p \land \forall q \in \text{Sub}(p)[\neg O(q)] \]

(i) Presupposition: \( p \) has some sub-alternatives.

(ii) Assertion: \( p \) is true, while the exhaustification of each sub-alternative of \( p \) is false.

b. \[ \text{Sub}(p) = \text{Alt}(p) - \text{IExcl}(p) - \{p\} \]

(the set of alternatives excluding the innocently excludable alternatives and the prejacent)

### 5.3 Modal Obviation

Recall the contrast between disjunctions and bare wh-words: **dou** alone is sufficient to license the universal FC use of a bare wh-word, but not that of a disjunction. To capture this contrast, I assume that disjunctions evoke scalar implicatures, while bare wh-words do not (compare Liao 2011; Chierchia & Liao 2015). Compare the episodic sentences in (48). In both
examples, exercising *dou* yields an FC inference *that John & Mary / everyone have / has taught Intro Chinese*; but (48a) also evokes a scalar implicature, namely *that not both John and Mary have taught Intro Chinese*.

    John or Mary *DOU* teach -EXP intro Chinese  
    ‘Everyone has taught Intro Chinese.’

b. [Shei] *(dou)* jiao -guo jichu hanyu.  
    who *DOU* teach -EXP intro Chinese  
    ‘Everyone has taught Intro Chinese.’

Hence, *dou* cannot be used in (48a) because it yields a universal FC inference which contradicts the scalar implicature, à la Chierchia’s (2013) explanation on the licensing condition of the FC *any*. In absence of *dou*, the sub-alternatives of a disjunction are not activated, and then (48a) simply means *that John or Mary but not both has taught Intro Chinese*.

A pre-verbal disjunction is licensed as a universal FCI when it appears before *dou* + ◊. This effect is called “modal obviation”, namely that the presence of a possibility modal eliminates the ungrammaticality. This effect is also observed with the English *any*, as seen in (41).

(49) a. [Yuehan huozhe Mali] *dou* keyi jiao jichu hanyu.  
    John or Mary *DOU* can teach intro Chinese  
    ‘Both John and Mary can teach Intro Chinese.’

b. [Yuehan huozhe Mali] (*dou*) bixu jiao jichu hanyu.  
    John or Mary *DOU* must teach intro Chinese  
    ‘Both John and Mary can teach Intro Chinese.’

There have been a plenty of discussions on the phenomenon of Modal Obviation involved in licensing universal FCIs. Representative works include Dayal (1998, 2013), Giannakidou (2001), Chierchia (2013), and among the others. This paper is not in a position to do full justice to these discussions, but just adds one more accessible story to the market.

I propose that the scalar implicature of a pre-verbal disjunction can be assessed within a circumstantial modal base: the modal base is restricted to the set of worlds where the scalar implicature is satisfied. For instance, (49) intuitively suggests that *the speaker is only interested in cases where exactly one person teaches Intro Chinese*. Assume that the property teach
Intro Chinese denotes only three world-individual pairs, as in (50a). For instance the pair ⟨w1, {j}⟩ is read as only John teaches Intro Chinese in w1. The scalar implicature of the pre-verbal disjunction restricts the modal base into M, namely the set of worlds where not both John and Mary teach Intro Chinese. Exercising dou yields the universal FC inferences in (50c) and (50d). Crucially, only (50c) is true under M.

(50) a. \( f = \{⟨w1, \{j\}⟩, ⟨w2, \{m\}⟩, ⟨w3, \{j, m\}⟩\} \)

b. \( M = \{w1, w2\} \)

c. \( [\text{dou}] [◊f(j) \lor ◊f(m)] = ◊f(j) \land ◊f(m) \) True under M

d. \( [\text{dou}] [□f(j) \lor □f(m)] = □f(j) \land □f(m) \) False under M

More broadly speaking, there is no modal base, except the empty one, under which (50d) is true; therefore necessity modals cannot obviate the contradiction between the FC inference and the scalar implicature.

6 Scalar marker

When dou is associated with a scalar item or occurs in the focus construction [lian Foc dou ...], it functions as a scalar marker. In such a case, sub-alternatives are the alternatives that rank lower than the prejacent with respect to a contextually relevant probability measure, and the pre-exhaustification effect is realized by the scalar exhaustifier just. In the following, I will firstly sketch out the semantics of a scalar dou, and then capture the ‘even’-like interpretation and the licensing conditions of minimizers in the [lian Foc/Min dou ...] construction.

6.1 Association with a scalar item

When dou is associated with a scalar item, the sub-alternatives are alternatives that rank lower than the prejacent proposition in the considered scale, as schematized in (51), where \( q <_\mu p \) says that q is less likely than p with respect to some contextually relevant probability measure \( \mu \). For instance, in (52), sub-alternatives are propositions that rank lower than the prejacent in chronological order.

(51) \( Sub(p) = \{q : q \in C \land q <_\mu p\} \)

(\( \{q : q \) is a contextually relevant alternative of p that rank lower than p in the considered scale\})
(52) Dou [WU-dian] -le.
   DOU five-o’clock -ASP
   ‘It is dou [FIVE] o’clock.’
   a. Sub(it’s 5 o’clock ) = {it’s 4 o’clock, it’s 3 o’clock, ...}
   b. [dou[it’s 5 o’clock]] = ‘it’s 5, not just 4, not just 3, ...’

Since here the alternatives are ordered based on their strength in the
considered scale, the pre-exhaustification effect of dou is realized by the
scalar exhaustifier JUST. Therefore, dou is defined as in (53) when it func-
tions as a scalar marker.

(53) [dou](p) = ∃q ∈ Sub(p).p ∧ ∀q ∈ Sub(p)[¬JUST(p)]
   a. Sub(p) = {q : q ∈ C ∧ q <µ p}
      (the set of contextually relevant alternatives that are ranked
lower than p in the considered scale)
   b. JUST(p) = λw.p(w) ∧ ∀q ∈ C[q(w) → q ≤µ p]
      (p is true; every contextually relevant true alternative of p
does not rank higher than p in the considered scale)

To generate sub-alternatives and satisfy the additive presupposition
of dou, the prejacent needs to be relatively strong among the quantifica-
tional statements. For instance in (54), dou can be associated with ‘many-
NP’ but not with ‘few-NP’.

(54) [Duo/*Shao -shu -ren] dou lai -le.
    many/less -amount -person DOU come -ASP
    ‘Most/*few people dou came.’

6.2 The [lian Foc dou...] construction
In a [lian Foc dou ...] construction, alternatives are ordered with respect
to likelihood. Sub-alternatives are focus alternatives that are less unlikely
(i.e., more likely) to be true than the prejacent, as schematized in (55). Here
the variable C is a set of focus alternatives that are contextually
relevant. This definition is a natural transition from informativity to like-
lihood: a proposition that is less informative is less unlikely to be true.

(55) Sub(p) = {q : q ∈ C ∧ q <unlikely p}
\{q \colon q \text{ is a contextually relevant alternative of } p \text{ that is less unlikely to be true than } p\}\

For instance in (56), the set \(C\) consists of propositions of the form “\(x\) was late” where \(x\) is a relevant individual, and sub-alternatives are the team member \(A\) was late, the team member \(B\) was late, …. Thus (56) means that the team leader was late, not just that a team member was late.

(56) \textbf{Lian} [\textit{duizhang}]_F \textbf{dou} \textit{chidao} -le.
\begin{align*}
\text{LIAN} & \quad \text{team-leader DOU late -ASP} \\
& \quad \text{‘Even the team leader was late.’}
\end{align*}

Extending the definition of \textit{dou} to the [\textit{lian} Foc \textit{dou} ...] construction, I schematize the meaning of \textit{dou} as follows. The underlined inference, namely that every alternative that is less unlikely to be true than \(p\) is less unlikely to be true than some true alternative, is asymmetrically entailed by the rest asserted part, namely that \(p\) is true. Hence, the asserted component of \textit{dou} simply affirms its prejacent.

(57) \[\lbrack \textit{dou} \rbrack(p)
\begin{align*}
& = \exists q \in \text{Sub}(p).p(w) \land \forall q \in \text{Sub}(p)[\neg \text{JUST}(p)(w)] \\
& = \lambda w.\exists q \in C[q <_{\text{unlikely}} p].p(w) \land \\
& \quad \forall q \in C[q <_{\text{unlikely}} p \rightarrow \exists q' \in C[q'(w) \land q <_{\text{unlikely}} q']] \\
& = \exists q \in C[q <_{\text{unlikely}} p].p
\end{align*}

Notice that the presupposition of the scalar marker \textit{dou} is simply the scalar presupposition of the additive scalar focus-sensitive operator \textit{even}, according to the tradition initiated by Bennett (1982) and Kay (1990): ‘the prejacent proposition is less likely to be true than at least one contextually relevant alternative.’\footnote{Note that this additive presupposition says nothing about the truth value of any sub-alternative, as shown in (i).} Thus, it is plausible to say that the ‘even’-like interpretation of the [\textit{lian} Foc \textit{dou} ...] construction comes from the pre-

(i) \textbf{Lian} [\textit{Yuehan}] \textbf{dou} \textit{jige} -le, qita-ren \textit{zenme} \textit{mei} -you?
\begin{align*}
\text{LIAN} & \quad \text{John D OU pass -ASP, other-person how NEG -ASP.} \\
& \quad \text{‘Even John passed [the exam]. Why is that the others didn’t?’}
\end{align*}
supposition of *dou* (Portner 2002; Shyu 2004; Paris 1998; Liu 2016), while that the particle *lian* is simply a focus marker and is present just for syntactic purposes.

## 6.3 Association with a minimizer

Observe that, in licensing a minimizer, the post-*dou* negation is mandatory in (58a) but optional in (58b). I argue that the distributional pattern of the post-*dou* negation in a [*lian* MIN *dou* (NEG) ... ] construction is constrained by the additive presupposition of *dou*.

(58)  

a. Yuehan (lian) [YI-ge ren]_F *(dou) *(bu) renshi.  
   John LIAN one-CL person DOU NEG know  
   ‘John doesn’t know anyone.’

b. Yuehan (lian) [YI-fen qian]_F *(dou) (bu) yao.  
   John LIAN one-cent money DOU NEG request  
   Without negation: ‘John even doesn’t want one cent.’  
   With negation: ‘John wants it even if it is just one cent.’

The additive presupposition of *dou* requires the prejacent not to be weakest proposition among the alternatives. In (58a), this requirement forces the minimizer ‘one person’ to take reconstruction and gets interpreted below negation: *there is at least one person that John didn’t invite* is weaker than *there are at least N people that John didn’t invite* where \( N > 1 \); while \( \neg[\text{John invited at least one person}] \) is stronger than any propositions of the form \( \neg[\text{John invited at least N people}] \) where \( N > 1 \). Compare, (59) is ungrammatical: the minimizer ‘one person’ is a subject and its reconstructed position is higher than negation; hence there is no structure under which the presupposition of *dou* is satisfied.

(59)  

* (Lian) [YI-ge ren]_F *dou bu renshi Yuehan.  
   LIAN one-CL person DOU NEG know John.

In (58b), under the assumption that John shouldn’t want the money if the money is too little, we expect that *John wants one cent* is more unlikely to be true than *John wants two cents*; therefore, the additive presupposition of *dou* can be satisfied even in absence of the post-*dou* negation.
7 Conclusions
In this paper, I offered a uniform semantics to capture the seemingly diverse functions of Mandarin particle *dou*, including the quantifier use, the FCI-licenser use, and the scalar use. I proposed that *dou* is a special exhaustifier that operates on sub-alternatives and has a pre-exhaustification effect: *dou* presupposes the existence of at least one sub-alternative, asserts the truth of the prejacent and the negation of each pre-exhaustified sub-alternative.

In a basic case, sub-alternatives are alternatives that are not innocently excludable and distinct from the prejacent, and the pre-exhaustification effect is realized by a regular exhaustifier (viz. the *O*-operator). Depending on the meaning of its associated item, *dou* functions either as a universal quantifier or as a universal FCI-licenser.

When *dou* is applied to a scalar statement, sub-alternatives are alternatives less unlikely than the prejacent sentence with respect to the considered probability measure, and the pre-exhaustification effect is realized by the scalar exhaustifier *just*.

The additive presupposition of *dou* explains the distributional pattern of *dou* and many of its semantic consequences, such as the requirements regarding to distributivity, plurality, and monotonicity, the ‘even’-like interpretation of [lian Foc dou ...] construction, the distributional pattern of the post-*dou* negation in licensing minimizers, and so on.

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References


Horn, Laurence. 1969. A presuppositional analysis of only and even. In *Proceedings of chicago linguistics society 5*.


form and interpretation 269–300.


