Abstract  Many languages have particles that possess multiple logical functions. Take the Mandarin particle *dou* for example. Varying by the item it is associated with and the prosodic pattern of the environment it appears in, *dou* can trigger a distributivity effect, license a pre-verbal free choice item, or evoke an *even*-like inference. Considering universal grammar a simple system, we need to figure out, for a multi-functional particle, which of its functions is primary, what parametric variations are responsible for the alternations in function, and how these variations are conditioned.

In this paper, I argue that the seemingly unrelated functions of *dou* share the same source: *dou* is a pre-exhaustification exhaustifier operating on sub-alternatives. Uniformly, *dou* affirms the truth of its propositional prejacent, negates the exhaustification of each sub-alternative, and presupposes a non-vacuity inference that there is at least one sub-alternative. Alternations in function result from minimal weakening operations on the semantics of sub-alternatives. In particular, sub-alternatives are primarily weaker alternatives, and the non-vacuity presupposition of *dou* yields a distributivity effect. When the semantics of sub-alternatives is weakened under particular syntactic or prosodic conditions, *dou* gains its other logical functions.

1. Introduction

The Mandarin particle *dou* is known for its diversity of function. As a rough classification, *dou* can be used as a quantifier-distributor, a free choice item (FCI-)licenser, and a scalar operator. This paper presents a uniform semantics of *dou* to capture the seemingly different functions it possesses. I propose that *dou* is a special exhaustifier with a pre-exhaustification effect. The basic idea of my proposal is as follows. For a *dou*-sentence of the form “*dou*(S A)” where S is the prejacent clause and A is the associate of *dou*, its meaning is roughly ‘S A′’ where A′ is what I call a “sub-alternative” of A, which can be a proper subpart of A, a weak scale-mate of A, or a disjunction of A, and so on. For example, “John and Mary *dou* came” means that John and Mary came, not only John came, and not only Mary came; “it’s *dou* five o’clock” means that it’s five o’clock, not just four o’clock, not just three o’clock, .... I will argue that the alternations in function of *dou* come from the variations on what counts as a sub-alternative.

The diversity of function of *dou* raises two fundamental questions related to natural language semantics: what does the underlying logical system of universal grammar (UG) look like, and how are the basic functions in natural languages semantics generated from this system? The semantics of logical words (e.g., connectives and quantifiers) are likely to be components of UG, namely, the initial state of the language learner (Chierchia 2016). Nevertheless, cross-linguistically, many functional particles possess more than one basic logical function. As Gil (2013) reports, 67% of world’s languages have such multi-functional particles. Typical examples include Mandarin particles *dou* and *ye*, and Japanese particles *ka* and *mo*,\(^1\) and so on. It is

\(^1\)There is a rich literature on the semantics of Japanese particles *ka* and *mo*. Representative works in contemporary semantics include: Kratzer and Shimoyama (2002); Mitrović (2014); Slade (2011); Szabolcsi (2010, 2015); Mitrovic and Sauerland (2014), among others.
unlikely that our language system would this frequently assign a word multiple unrelated logical meanings as its lexical interpretations. While exceptions are possible, in most cases, the functions possessed by a logical word should have primarily the same source, and the alternations in function should be consequences of minimal variations. The Mandarin particle *dou*, with a long history for at least 1800 years (Gu 2015), is an excellent case to study the underlying logical system of UG.

The rest of this paper is organized as follows. Section 2 describes the three basic uses of *dou*, including the quantifier-distributor use, the FCI-licenser use, and the scalar operator use. Section 3 discusses the advantages and problems of two representative approaches to the semantics of *dou*, including the distributor approach (Lin 1998) and the maximizer approach (Giannakidou and Cheng 2006; Ming Xiang 2008). Section 4 starts with Alternative Semantics and the meaning of the canonical exhaustifier only. Then it outlines a preliminary treatment for the semantics of *dou* in analogy to that of only. Section 5 derives the three basic uses of *dou* and explains the relevant semantic effects. Section 6 discusses the alternations in function of *dou*. Section 7 concludes. Appendix A reviews a competing approach suggested by the reviewers, which contributes the derivation of FC to recursive exhaustifications. Appendix B reviews the analyses by Liao (2011) and Liu (2016b,c, 2018), which also implement Alternative Semantics and exhaustification.

2. Describing the uses of *dou*

2.1. Quantifier-distributor

In a basic declarative sentence, *dou* is associated with a preceding nominal expression and universally distributes over the subparts of the denotation of its associate, as exemplified in (1). This use of *dou* is similar to the post-nominal use of the English particle *all*. Here and throughout this paper, the associate of *dou* is enclosed in “[*]”.

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

b. [Tamen] **dou** ba naxie wenti da dui -le. they DOU BA those question answer correct -ASP
‘They all correctly answered those questions.’

c. Tamen ba [naxie wenti] **dou** da dui -le. they BA those question **dou** answer correct -ASP
‘They correctly answered all of those questions.’

In the quantifier-distributor use, *dou* brings up three semantic consequences in addition to universal quantification, namely, a “maximality requirement,” a “distributivity requirement,” and a “plurality requirement.” Names of these requirements are quoted because they are used in a descriptive manner. Later, I will argue that both of the latter two requirements are illusions. The “maximality requirement” means that the presence of *dou* forces the predicate denoted by the remnant VP to be applied to the maximal element in the extension of *dou*’s associate (Ming Xiang 2008). For instance, in a discourse that a large group of children, with one or two exceptions, went to the park, the sentence in (2) is acceptable only if *dou* is absent.
The “distributivity requirement” says that if a sentence admits both collective and (atomic or non-atomic) distributive readings, then adding dou to this sentence blocks the collective reading (Lin 1998). For instance, the presence of dou in (3) is infelicitous if the considered individuals all together participated in only one house-buying event.

(3) (Scenario: The considered individuals all together bought only one house.)

[Tamen] (#dou) mai -le  fangzi.

They (#all) bought house(s).'

The “plurality requirement” says that the associate of dou, overt or covert, must be non-atomic. If the prejacent clause of dou does not contain an overt non-atomic nominal item, dou has to be associated with a covert non-atomic item. For example, in (4), since the overt part of the prejacent clause has no non-atomic item, dou is associated with a covert item such as mei-ci ‘every time’.2

(4) Yuehan [(mei-ci)]  dou  qu de Beijing.

Every time, the place that John went to was Beijing.’

2.2. FCI-licenser

As a well-known fact, in Mandarin, pre-verbal wh-expressions and renhe ‘any’-expressions can function as universal (∀-)FCIs when they precede the particle dou, as exemplified in (5).

(5) [Shei/ Na-ge-ren/ Renhe-ren] *(dou) keyi jiao jichu hanyu.

Anyone can teach Intro Chinese.’

More interestingly, in Yimei Xiang (2016b), I observe that associating dou with a pre-verbal disjunction also evokes a ∀-FC inference, as shown in (6a). Here, while the prejacent clause is a disjunction, associating the pre-verbal disjunction with dou yields a conjunctive inference.3

3One might find it appealing to interpret dou in (4) as ‘only’ and associate it with Beijing, paraphrasing the sentence as ‘for all the times, John only went to Beijing.’ However, the following example excludes this possibility: the covert mei-ci ‘every time’ appears under the predicate xiang ‘want’, forcing dou to appear within the embedded clause.

(i) Wo (*dou) xiang [(mei-ci)] (dou) qu Beijing.

I dou want every-time dou go Beijing.

Intended: ‘I want it to be the case that I go to Beijing every time.’

3My own intuition does not accept a ∀-FC reading for the without-dou sentence (6a). However, in an informal survey, judgments from 52 native speakers of Mandarin were divergent: 22 speakers accepted only the simple disjunction reading, 24 accepted only the FC reading, and the rest 6 accepted both readings but their preferences were divergent. In particular, 4 out of the 6 speakers who accepted both readings reported that they got the FC reading if unconsciously inserting a silent dou into the sentence, and that they got the simple disjunction reading if consciously avoiding doing so. Hence, there seems to be two types of speakers: “disjunction speakers” and “FC speakers”. FC speakers read sentences like (6a) with a covert dou. While disjunction speakers resist a covert dou, due to probably the economy principle that a language-specific operator should not be used covertly if it can be used overtly (Chierchia 1998).
(6) a. [Yuehan huozhe Mali] keyi jiao jichu hanyu.
   ‘Either John or Mary can teach Intro Chinese.’

b. [Yuehan huozhe Mali] **dou** keyi jiao jichu hanyu.
   John or Mary **dou** can teach intro Chinese
   Intended: ‘Both John and Mary can teach Intro Chinese.’

2.3. Scalar marker

There are two types of structures where **dou** functions as a scalar operator. One is the [lian Foc **dou** ...] construction where **dou** is associated with an expression in the focal position, and the other is where **dou** is associated with an in-situ focused scalar item.

First, the [lian Foc **dou** ...] construction evokes an even-like inference that the prejacent proposition is less likely than at least some of its contextually relevant alternatives, as exemplified in (7). In the [lian Foc **dou** ...] construction, the presence of **lian** is optional, but the associate of **dou** must be stressed.

(7) (Lian) [DUIZHANG_F] **dou** chi dao -le.
   lian team-leader **dou** late arrive -ASP
   ‘Even [the team leader] arrived late.’
   \( \rightarrow \) The team leader is less likely to arrive late (than a regular team member).

In particular, a numeral phrase of the form “one-cl-NP” can be licensed as a minimizer at the focal position in a [lian Foc **dou** neg ...] construction, as shown in (8a). Interestingly, as C.-T. James Huang (pers. comm.) points out, the post-**dou** negation is sometimes optional, as in (8b).

In the presence of negation, (8b) means that John does not want any money; in the absence of negation, (8b) means that John is very greedy and wants to take any money regardless of how little amount that is.

(8) a. Yuehan (lian) [YI_F-ge ren] *(**dou**) *(mei) qing.
   John **lian** one-cl person **dou** neg invite
   ‘John didn’t invite even one person.’

\[4\] \( \rightarrow \) p’ means that the Mandarin sentence implies the inference p. Here and throughout the paper, stressed items are capitalized, and focused items are marked with a subscript ‘F’.

\[5\] In many cases, a non-subject associate of **dou** can also be left in-situ, as exemplified in the following:

(i) a. Ta (lian) [NANJI_F] **dou** qu -guo -le.
   he **lian** Antarctica **dou** go -EXP -ASP
   ‘He even has been to Antarctica.’

b. Ta **dou** qu -guo [NANJI_F] -le.
   he **dou** go -EXP Antarctica -ASP
   ‘He even knows the chairman.’

(ii) a. Ta (lian) [XIAOXUE_F] **dou** mei shang -guo. 
   he **lian** primary-school **dou** neg go -EXP
   ‘He hasn’t even been to primary school.’

b. Ta **dou** mei shang -guo [XIAOXUE_F].
   he **dou** neg go -EXP primary-school
   ‘He even has been to primary school.’

However, there are still quite a few exceptions, which seem to be conditioned by the aspectual class of the sentence: as seen in the following, to place the focused associate of **dou** in the in-situ position, the prejacent of **dou** has to express an accomplishment. Since the aspectual system of Mandarin is very complex, I will not dive into this puzzle in this paper.

(iii) a. Ta (lian) [ZHUXI_F] **dou** renshi.
   he **lian** chairman **dou** know
   ‘He even knows the chairman.’

b. *Ta **dou** renshi [ZHUXI_F].
   he **dou** know chairman
b. Yuehan (lian) [YI Fen qian] *(dou) (bu) yao.
   John LIAN one-cent money DOU NEG want
   With negation: ‘John does not want even one cent.’
   Without negation: ‘Even if it is just one cent, John wants it.’

Second, *dou* can also be associated with an in-situ scalar item. In this case, *dou* implies that its prejacent proposition ranks relatively high with respect to a contextually relevant measurement. For example, in (9a), *dou* is associated with the scalar phrase *wu-dian* ‘five o’clock’, and the alternatives are ranked in chronological order. When *dou* has this use, its associate can stay in-situ but must be accented.

(9) a. **Dou** [wu-dian] -le.
   DOU five-o’clock -ASP
   ‘It is five o’clock.’
   ⇒ It’s too late.

   he dou already come -EXP here two-time -ASP.
   ‘He has already been here twice.’
   ⇒ Being here twice is quite a lot (for him).

2.4. Disambiguation

If a sentence has multiple expressions that can be used as an associate of *dou*, the function of *dou* and the association relation can be disambiguated by stress. Compare the following three sentences which differ in prosody:

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

b. (Lian) [TAMEN] dou lai -guo liang-ci -le.
   LIAN they DOU come -EXP two-time -ASP
   ‘Even THEY have been here twice.’
   ⇒ Compared with some other people, they are less likely to come here twice.

   they DOU come -EXP two-time -ASP
   ‘They’ve even been here TWICE.’
   ⇒ Being here twice is a lot for them.

In (10a), where the prejacent of *dou* has no stressed item, *dou* functions as a quantifier-distributor and is associated with the preceding plural term *tamen* ‘they’. While in (10b-c), *dou* functions as a scalar operator and is associated with the stressed item.

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6Note that the scalar operator use of *dou* in (9) is different from the non-scalar use in the following sentences, where *dou* is associated with the main verb, which is clearly non-scalar.

      John DOU come -EXP here one-cl -ASP
      ‘John has been here once.’
      rain DOU stop -ASP
      ‘The rain has stopped.’

Descriptively, here *dou* is used to emphasize the contrast between the status where a change has taken place (such as the status where John has been here, or it starts raining) and the status where this changed has not taken place (such as the status where John has not been here, or the rain has not started). So far, I do not have an explanation for this use of *dou*.
3. Previous studies

There are numerous studies on the syntax and semantics of *dou*. Earlier approaches treat *dou* as an adverb that expresses universal quantification (Ma 1983; Lee 1986; Cheng 1995; Jiang 1998; Pan 2006; among others). Huang (1996) and Yuan (2005) treat *dou* as a sum operator over events. Portner (2002) analyzes the scalar operator use of *dou* in a way similar to the English focus-sensitive particle *even* which has an inherent scalar meaning. Liao (2011) and Liu (2016b,c, 2018) also define *dou* as *even*, and they derive the distributor use of *dou* based on a universal scalar presupposition. Hole (2004) treats *dou* as a universal quantifier ranging over the domain of alternatives. This section will review two representative views on the semantics of *dou*, including the distributor approach by Lin (1998) and the maximizer approach by Giannakidou and Cheng (2006) and Ming Xiang (2008). Reviews on Liao (2011) and Liu (2016b,c, 2018) are postponed to Appendix B because these two analyses involve technicalities that will be introduced in later sections.

3.1. The distributor approach

Lin (1998) provides the first extensive treatment of the semantics of *dou*. He treats *dou* as an overt counterpart of the generalized distributor *Part* in the sense of Schwarzschild (1996), as defined in (11), where *x* stands for the associate of *dou* and *P* for the predicate that *dou* combines with.

\[(11) \text{ Semantics of } \textit{dou} \text{ (Lin 1998)} \]

\[\text{“}x \text{ dou } P\text{” is true iff Part}_{C}(P, x) = 1,\]

\[\text{iff } \forall y \in C[y \leq x \rightarrow P(y)] \text{ where } C \text{ is a cover of } x.\]

The *Part*-operator distributes over the cover of its associate. A cover of an entity *x* is a set of atomic or non-atomic subparts of *x*, as defined in (12). The value of a cover is determined by both linguistic and non-linguistic factors.

\[(12) \text{ C is a cover of } x \text{ (written as } \textit{Cov}(C, x) = 1') \text{ iff}\]

- a. *C* is a set of subparts of *x*;
- b. every subpart of *x* belongs to some member of *C*.

When a cover consists of only atomic elements, *Part* distributes down to atoms, yielding an atomic distributive reading. When a cover is singleton, distributivity is trivial, and applying *Part* returns a collective reading. In other cases, applying *Part* gives rise to a non-atomic distributive reading. For example, if the cover of \(a \oplus b \oplus c\) is \(\{a \oplus b, c\}\), ‘*abc dou* bought houses’ means that *ab* together bought a house and *c* alone bought a house.

\[(13) \text{ Possible covers of } a \oplus b \oplus c \text{ and the corresponding readings of } \textit{abc dou} \text{ bought houses:}\]

\[
\{a, b, c\} \quad \text{Atomic distributive} \quad \text{‘*abc each bought houses’}\]

\[
\{a \oplus b, c\} \quad \text{Non-atomic distributive}\]

\[
\{a \oplus b, b \oplus c\} \quad \text{Collective} \quad \text{‘*abc together bought houses’}\]

The distributor approach by Lin only considers the quantifier-distributor use of *dou*. It is unclear how this approach extends to the other uses, such as the FCI-licenser use and the
scalar operator use. Moreover, even for the quantifier-distributor use, this approach faces two challenges. First, *dou* evokes a distributivity requirement, but the Part-operator does not. As Ming Xiang (2008) argues, if *dou* were a generalized distributor, it should be compatible with a collective reading. For example, in (14), repeated from (3), if tamen ‘they’ refers to the sum individual \( a \oplus b \oplus c \), there can be a discourse in which the cover of tamen ‘they’ is \{ a \oplus b \oplus c \}, and then Lin predicts that *dou* trivially distributes over this singleton set, yielding a collective reading, contra fact.

(14) [Tamen] *dou* mai -le fangzi.
    they *dou* buy perf house
    ‘They *dou* bought houses.’ (#collective)

Second, as shown by the contrast between (15a-b) and (15c), unlike English distributors like *each* and *all*,7 Mandarin *dou* can be associated with a distributive expression such as NP-gezi ‘NP each’.8

(15) a. Each of the five investors (*each/*all) invested in one startup.
    b. The five investors each (*each/*all) invested in one startup.
    c. [Zhe wu-ge touziren gezi] (dou) touzi -le yi-jia chuangye gongsi.
        This five-cl investor each *dou* invest perf one-cl startup company
        ‘The five investors each *dou* invested in one startup.’ (atomic distributive)

3.2. The maximizer approach

Another representative approach, initiated by Giannakidou and Cheng (2006) and extended by Ming Xiang (2008), treats *dou* as a maximizer. Briefly, this approach assumes that *dou* has the following semantic characteristics: (i) it operates on a non-singleton cover of its associate and returns the maximal plural element in this cover, and (ii) it presupposes the existence of this maximal plural element. Since their original papers do not have a formal definition, I schematize this idea as follows:

(16) Semantics of *dou* (based on Giannakidou and Cheng 2006 and Ming Xiang 2008)

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

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

7Champollion (2015) argues that *all* is a distributor that distributes down to subgroups, while that *each* distributes all the way down to atoms.
8In (15c), the NP-gezi is not a constituent — gezi is a distributive adverbial associated with the subject NP. More precisely, (15c) shows that *dou* can appear in the scope of a distributor and be associated with the distributed phrase. Similar arguments have been reached by Cheng (2009) and others, but they mostly draw 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: observe in (i) that stress falls on the distributive phrase mei-cl-NP, not the particle *dou*; therefore, here *dou* might function as a scalar operator, not as a quantifier-distributor.

(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
The maximizer analysis of dou is similar to the standard treatment of the definite determiner the (Sharvy 1980, Link 1983): the picks out the unique maximal element in the extension of its NP-complement and presupposes the existence of this maximal element.

\[
\text{[[the]]}(P_{\{x, f\}}) = \exists x [x \in P \land \forall y \in P[y \leq x]]. x \in P \land \forall y \in P[y \leq x]
\]

(17) \text{[[the]]}(P_{\{x, f\}}) is defined only if there is a unique maximal object \(x\) such that \(P(x)\) is true; when defined, the reference of \text{[[the]]}(P_{\{x, f\}}) is this maximal element.)

On the upside, the maximizer approach predicts the maximality requirement, and it can extend to the scalar use of dou (see Ming Xiang 2008). However, this approach is problematic in two respects. First, it predicts no distributivity effect at all. In this approach, a dou-sentence of the form “[x] dou did f” would only assert 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 the set \(\{a \oplus b, a \oplus b \oplus c\}\), then the assertion predicted by the maximizer approach would be ‘a \oplus b \oplus c bought houses,’ which says nothing as to whether \(a \oplus b\) bought houses. Second, the plurality requirement comes as a stipulation on the presupposition of dou: dou presupposes that the selected maximal element is non-atomic. It is quite ad hoc to assume that dou has a plural presupposition while that the other maximizers, such as the definite determiner the, do not have this presupposition. Moreover, as will be seen in section 5.1.2, the so-called “plurality requirement” is illusive; this plural presupposition is neither sufficient nor necessary for accounting for the relevant facts.

4. Defining dou as a special exhaustifier

In this section, I will start by introducing the basics of Alternative Semantics and the meaning of the canonical focus (F-)sensitive exhaustifier only. Next, I will define the particle dou as a special exhaustifier in parallel to only.

4.1. Alternative Semantics

Rooth (1985) assumes that a meaningful linguistic expression \(\alpha\) is associated with a set of focus (F)-alternatives ‘F-Alt(\(\alpha\))’ (also called the focus value of \(\alpha\) and written as ‘[[\(\alpha\)]\(F\)’). F-alternatives of a focused simple expression are meanings of the same semantic type as this focused expression, as defined in (18a). The set of F-alternatives grows point-wise (Hamblin 1973, Rooth 1992), as defined in (18b).

\[
\text{F-alternatives}
\]

a. For any lexical expression \(\alpha\),

\[
\text{F-Alt}(\alpha) = \begin{cases} 
\text{Dtype}([[\alpha]]) & \text{if } \alpha \text{ is focused} \\
[[\alpha]] & \text{otherwise}
\end{cases}
\]

b. \(\text{F-Alt}(\beta(\alpha)) = \{b(\alpha) \mid b \in \text{F-Alt}(\beta), a \in \text{F-Alt}(\alpha)\}\)

The following tree diagram illustrates the composition of F-alternatives. This structure is annotated with the set of F-alternatives at every node.
Focus placement itself has no truth-conditional effect. For example, in responding to the question in (20), stressing Mary makes the answer infelicitous but not false.

Who did Mary invite?

a. Mary invited JOHN$_F$.

b. #MARY$_F$ invited John.

However, in the presence of an associated exclusive particle only, focus placement may affect the truth conditions, as shown in (21).

John only introduced BILL$_F$ to Sue.

$\sim$ John didn’t introduce anyone to Sue except Bill.

b. John only introduced Bill to SUE$_F$.

$\sim$ John didn’t introduce Bill to anyone except Sue.

We call only a F-sensitive operator (Jackendoff 1972). Prototypical F-sensitive operators also include exclusive particles such as merely, just, exclusively, and additive particles such as also, even, additionally, too. Rooth (1992, 1996) accounts for the F-sensitivity effect of only based on a condition that constrains the domain of only: for a sentence of the form “only$_C$(S)” where $C$ is a context-dependent domain variable and $S$ is the prejacent clause, $[[\text{only}_C(S)]]$ is defined only if $C \subseteq \text{F-Alt}(S)$. More generally:

Focus Condition

For any F-sensitive operator $\Theta$ such that $\Theta$ quantifies over a domain $C$ and combines with a focus-containing expression $\delta$, $[[\Theta_C(\delta)]]$ is defined only if $C \subseteq \text{F-Alt}(\delta)$.

In addition to F-alternatives, subsequent works on Alternative Semantics discuss two more types of alternatives, namely, scalar ($\sigma$-)alternatives of scalar items (Sauerland 2004) and domain (D-)alternatives of disjunctions or quantifiers (Kratzer and Shimoyama 2002; Sauerland 2004; Katzir 2007). Following Rooth’s idea that F-alternatives are activated by a grammatical feature [+f], Chierchia (2006, 2013) assumes that $\sigma$- and D-alternatives are activated by the [+s] feature and the [+d] feature, respectively. $\sigma$-alternatives are derived by replacing the scalar item with meanings belonging to the same scale, as in (23b). D-alternatives of the disjunctive connective

\begin{enumerate}
\item only($C_1$) $[\sim C_1 [S \ldots X_F \ldots]]$ \\
\item $[[C_1(S)]] = [S]$, defined only if $[C_1] \subseteq \text{F-Alt}(S)$
\end{enumerate}

Strictly speaking, F-sensitive operators cannot access F-alternatives directly. Instead, Rooth (1992) assumes that only makes reference to F-alternatives indirectly through a focus interpretation operator, written as ‘$\sim$’. As illustrated in (i), the $\sim$-operator first combines with a contextually determined F-domain variable $C$ and then with the prejacent of only, presupposing that $C$ denotes a subset of the set of F-alternatives $\text{F-Alt}(S)$. Further, Rooth (1992, 1996) assumes that only directly combines with a quantification domain variable, and that this quantification domain variable is co-indexed with the F-domain variable. These assumptions restrict the quantification domain of only to a set of contextually relevant F-alternatives of the prejacent sentence.

\begin{enumerate}
\item only($C_1$) $[\sim C_1 [S \ldots X_F \ldots]]$ \\
\item $[[C_1(S)]] = [S]$, defined only if $[C_1] \subseteq \text{F-Alt}(S)$
\end{enumerate}
or include the *join* meaning of the disjunctive itself (see footnote 10) and 2-place functions to its disjuncts, as in (24). As for quantifiers, Chierchia (2013: pp. 138) assumes that a quantificational determiner carries a syntactic domain variable $D$, interpreted via an assignment function $g$ as $g(D)$, and further that the $D$-alternatives of this quantifier are derived by assigning this variable a value that is a subset of $g(D)$, as in (25). The same as F-alternatives, $\sigma$-alternatives and D-alternatives grow point-wise.

(23) For any lexical expression $a$:

a. $F$-Alt$(a) = \begin{cases} D_{\text{type}}(\llbracket a \rrbracket) & \text{if } a \text{ carries a } [+t] \text{ feature} \\ \{\llbracket a \rrbracket\} & \text{otherwise} \end{cases}$

b. $\sigma$-Alt$(a) = \begin{cases} \{\llbracket a \rrbracket, ..., \llbracket a_n \rrbracket\} & \text{if } a \text{ carries a } [+\sigma] \text{ feature and} \\ \{\llbracket a \rrbracket\} & \text{otherwise} \end{cases}$

(24) For the disjunctive connective $or$

a. $D$-Alt$(or_{[+t]}) = \{\lambda b\lambda a.a \sqcup b, \lambda b\lambda a.a, \lambda b\lambda a.b\}$

b. $D$-Alt$(or_{[+\sigma]}) = \{\lambda b\lambda a.a \sqcup b\}$

(25) If $\alpha_D$ is a quantifier with a syntactic domain variable $D$:

$D$-Alt$(\alpha_D) = \begin{cases} \{[\llbracket \alpha_D \rrbracket]^{g[D \rightarrow D']} \mid D' \subseteq g(D)\} & \text{if } \alpha \text{ carries a } [+D] \text{ feature} \\ \{[\llbracket \alpha_D \rrbracket]^{g}\} & \text{otherwise} \end{cases}$

For example, for a disjunction of proper names *Andy or Billy*, its grammatical features and the activated alternatives are as follows. The plain/ordinary value of this disjunction is the join of two Montagovian individuals. The $[+f]$ feature is assigned to the entire disjunction, while the $[+\sigma]$ and $[+D]$ features are assigned to the disjunctive connective $or$.

(26) a. $\llbracket \text{Andy or Billy} \rrbracket = a^0 \sqcup b^0 = \lambda P.P(a) \lor P(b)$

b. $F$-Alt$(\llbracket \text{Andy or Billy} \rrbracket_{[+t]}) = D_{[\alpha,t]}$

c. $\sigma$-Alt$(\llbracket \text{Andy or \text{[+t, +\sigma]} Billy} \rrbracket)$

$= \{a^0 \sqcup b^0, a^0 \land b^0\} = \{\lambda P.P(a) \lor P(b), \lambda P.P(a) \land P(b)\}$

d. $D$-Alt$(\llbracket \text{Andy or \text{[+t, +\sigma]} Billy} \rrbracket)$

$= \{a^0 \sqcup b^0, a^0, b^0\} = \{\lambda P.P(a) \lor P(b), \lambda P.P(a), \lambda P.P(b)\}$

Footnote 10: Disjunctive is interpreted as the join operator ‘\text{\ljoin}\’, which must be applied to meanings of the same conjoinable type. The conjunctive $\text{\land}$ is treated as meet ‘\text{\land}’, defined analogously.

(i) **Join** (Partee and Rooth 1983, Groenendijk and Stokhof 1989)

$A \sqcup B = \begin{cases} A \lor B & \text{if } A \text{ and } B \text{ are of type } t \\ \lambda x_1[A(x) \sqcup B(x)] & \text{if } A \text{ and } B \text{ of a relational conjoinable type } \langle t, \sigma \rangle \\ \text{undefined} & \text{otherwise} \end{cases}$

Since entities are not of a conjoinable type, to be conjoined with join, they have to be first type-shifted into generalized quantifiers of a conjoinable type $\langle t, t \rangle$ via Montague-lift.

(ii) **Montague lift**

For any meaning $a$ of type $t$, the Montague-lifted meaning of $a$ is $a^\downarrow$ such that $a^\downarrow = \lambda m_{[t,t]} \cdot m(a)$.

A step-by-step computation of (26a) is as follows:

(iii) $\llbracket \text{Andy or Billy} \rrbracket = a^\downarrow \sqcup b^\downarrow$

$= (\lambda P'.P'(a)) \land (\lambda P'.P'(b))$

$= \lambda P[\lambda P'.P'(a)](P) \land (\lambda P'.P'(b))(P)$

$= \lambda P.P(a) \sqcup P(b)$

$= \lambda P.P(a) \lor P(b)$
Extending the Focus Condition to other alternative-activating features, I propose a more general condition as follows:

(27) **Domain restriction condition**
For any operator $\Theta$ such that $\Theta$ quantifies over a domain $C$ and combines with an expression $\delta$, if $\Theta$ agrees with an unchecked alternative-activating feature $[+x]$ of an expression in $\delta$, $[\Theta_C(\delta)]$ is defined only if $C \subseteq x$-$\text{Alt}(\delta)$.

### 4.2. Defining *only*

It is standardly assumed that *only* presupposes the truth of its prejacent proposition and asserts an exhaustivity inference (Horn 1969).

(28) Mary only invited JOHN.

a. $\sim$ Mary invited John. **Prejacent presupposition**

b. $\sim$ Mary didn’t invite anyone other than John. **Exhaustivity inference**

The exhaustivity inference is derived by negating all the contextually relevant F-alternatives of the prejacent clause that are excludable, as formalized in (29). Standardly, an alternative is excludable iff it is not entailed by the prejacent, as in (30).

(29) **The meaning of *only*** (To be revised in (32))

$[\textit{only}_C] = \lambda p \lambda w : p(w) = 1. \forall q \in \text{Excl}(p, C)[p \not\subseteq q \rightarrow q(w) = 0]$  

(30) **Excludable (excl-)**-alternatives **(Standard)**

$\text{Excl}(p, C) = \{ q \mid p \not\subseteq q \land q \in C \}$

Note that the definition of F-alternatives in (18) does not require F-alternatives to be contextually relevant, while the exhaustivity inference of *only* is only concerned with contextually relevant meanings. Hence, alternatives negated by *only* are chosen out of the domain $C$, a set of contextually relevant F-alternatives, not out of the full set of F-alternatives.

In addition to the above two inferences, I argue that *only* also triggers a non-vacuity presupposition, which requires the existence of an excludable (excl-)alternative. Consider (31) for illustration.

(31) Which of John and Mary will you invite?

a. Only JOHN, (not Mary / not both).

b. # Only BOTH.

c. BOTH.

The *which*-question restricts the quantification domain of *only* to the following set: $C = \{ \phi_j, \phi_m, \phi_{j\oplus m} \}$ where $\phi_x = \text{I will invite } x$. The response in (31b) is infelicitous because the propositional argument of *only*, namely $\phi_{j\oplus m}$, is the strongest proposition in $C$ and has no excl-alternative in $C$. This non-vacuity presupposition comes from a general economy condition that an overt operator cannot be applied vacuously (Martin Hackl pers. comm.; compare Al Khatib 2013). In comparison, the stressed bare adverb BOTH in (31c) is felicitous. Following the grammatical view, we can assume that the bare adverb BOTH is associated with a covert exhaustifier and that covert exhaustifiers are not subject to non-vacuity.
To sum up, I define the meaning of *only* as follows: *only* presupposes the truth of its propositional prejacent and the existence of an excl-alternative in its quantification domain; when the presuppositions are satisfied, it negates all the excl-alternatives of its prejacent.\footnote{For simplicity, this paper treats all F-sensitive operators propositional. A cross-categorical semantics of *only* is given in (i), where $f$ and $P$ stand for the left argument (i.e., the restrictor) and the right argument (i.e., the scope), respectively. By the Focus Condition, the quantification domain $C$ is a set of F-alternatives of the left argument.}

\begin{equation}
\text{The meaning of *only* (Final)}
\[ [\text{only}_C] = \lambda p \lambda w : \exists q \in \text{Excl}(p, C) \land p(w) = 1 . \forall q \in \text{Excl}(p, C) | q(w) = 0 \]
\end{equation}

a. *Non-vacuity presupposition*: The prejacent has at least one excl-alternative.

b. *Prejacent presupposition*: The prejacent is true.

c. *Exhaustivity assertion*: All the excl-alternatives are false.

4.3. Defining *dou* in analogy to *only*

I define the Mandarin particle *dou* as a special exhaustifier, in analogy to the canonical exhaustifier *only*. The same as *only*, as an overt functional particles, *dou* is subject to non-vacuity and presupposes the existence of an alternative that it operates on.

\begin{equation}
\text{The meaning of *dou*}
\[ [\text{dou}_C] = \lambda p \lambda w : \exists q \in \text{Sub}(p, C) . p(w) = 1 . \forall q \in \text{Sub}(p, C) | Q_C(q)(w) = 0 \]
\end{equation}

a. *Non-vacuity presupposition*: The prejacent has at least one sub-alternative.

b. *Prejacent assertion*: The prejacent is true.

c. *Anti-exhaustification assertion*: The exhaustification of each sub-alternative is false.

However, the semantics of *dou* and *only* have two contrasts.

I. Excl-alternatives versus sub-alternatives

While *only* operates on excl-alternatives, *dou* operates on sub-alternatives, which are complementary to excl-alternatives, as defined in (34).

\begin{equation}
\text{Sub-alternatives}
\[ \text{Sub}(p, C) = (C - \text{Excl}(p, C)) - \{p\} \]
\end{equation}

(Alternatives that are non-excludable and distinct from the prejacent)

If excl-alternatives are defined standardly as non-entailed alternatives, as in (30), sub-alternatives are simply alternatives asymmetrically entailed by the prejacent, as in (35).

\begin{equation}
\text{Sub-alternatives as weaker alternatives (By standard excludability)}
\[ \text{Sub}(p, C) = \{q \mid p \subset q, q \in C\} \]
\end{equation}

However, as will be seen in section 5, what counts as an excl-alternative is subject to variations — it depends on the quantification domain of the F-sensitive operator (namely, whether this domain consists of F-, σ-, or D-alternatives of the prejacent) and the measurement for ordering alternatives (such as logical strength, likelihood, or a contextually determined measurement). In
consequence, what counts as a sub-alternative is also subject to variations, causing alternations in function.

II. Exhaustivity versus anti-exhaustivity

While only asserts an exhaustivity inference, dou asserts an “anti-exhaustivity” inference, derived by negating the exhaustification of each sub-alternative. Hence, we say that dou has a “pre-exhaustification” effect (pace Chierchia 2013). In a basic case, pre-exhaustification is realized by applying an O-operator (also written as ‘Exh’) to each sub-alternative.12 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. 2012; Fox and Spector 2018; among others). As defined in (36), this O-operator affirms the prejacent and negates all the excl-alternatives of the prejacent.13

\[
\text{(36) The O-operator (Chierchia et al. 2012)}
\]

\[
O_C = \lambda p \lambda w : p(w) = 1 \land \forall q \in \text{Excl}(p, C) [q(w) = 0]
\]

(The prejacent is true, while all the excl-alternatives are false.)

In a basic case where excludability is defined standardly as in (30), the prejacent is excludable relative to its sub-alternatives, and the anti-exhaustivity inference collapses under the prejacent inference (i.e., the anti-exhaustivity inference is true whenever the prejacent is true). [Proof: Whenever \( p \) is true, any alternative of \( p \) that is weaker than \( p \) has a true excl-alternative \( r \), where \( r = p \). End of proof.] Hence, the default meaning of dou is vacuous in assertion. However, as will be seen in section 5.2, the assertion of dou can be non-vacuous under other definitions of excludability.

The following example shows how the proposed semantics of dou derives the distributor use. In (37), the prejacent and the domain of dou are schematized in (37b) and (37c), respectively. In the domain, the two alternatives in (37d) are asymmetrically entailed by the prejacent and are therefore sub-alternatives of the prejacent. Applying dou affirms the prejacent and negates the exhaustification of each sub-alternative, yielding the inference in (37e), read as ‘John and Mary arrived, not only John arrived, and not only Mary arrived.’ The anti-exhaustification inference given by the not only-clauses is entailed by the prejacent and thus does not affect the truth conditions.14

12When dou is used as a scalar operator, pre-exhaustification is realized by applying a scalar exhaustifier (≈ just) to each sub-alternative. This change is a logical consequence of redefining excl- and sub-alternatives based on likelihood. See details in section 5.3.

13Note that the O-operator is defined based on excludability, and that excl-alternatives are complementary to sub-alternatives. Hence, whether dou has a quantifier/distributor-like meaning of an even-like meaning purely depends what counts as a sub-alternative, as computed in the following:

(i) Defining dou based on sub-alternatives

\[
\begin{align*}
\text{O}_C & = \lambda q \lambda w : q(w) = 1 \land \forall r \in \text{Excl}(q, C) [r(w) = 0] \\
& = \lambda q \lambda w : q(w) = 1 \land \forall r \in ((C - \text{Sub}(q, C)) - \{q\}) [r(w) = 0] \quad \text{By (34)}
\end{align*}
\]

\[
\text{[douC]} = \lambda p \lambda w : \exists q \in \text{Sub}(p, C), p(w) = 1 \lor \exists q \in \text{Sub}(p, C)[O_C(q)(w) = 0]
\]

\[
= \lambda p \lambda w : \exists q \in \text{Sub}(p, C), p(w) = 1 \land \\
\forall q \in \text{Sub}(p, C)[q(w) = 0 \lor \forall r \in ((C - \text{Sub}(q, C)) - \{q\}) [r(w) = 0]] \quad \text{By (i-a)}
\]

This paper uses the more intuitive definition of dou in (33). However, keep in mind that the meaning alteration of dou is purely realized by the meaning variation of sub-alternatives.

14One might wonder why dou is used even though it does not change the truth conditions. Such uses are observed cross-linguistically. For instance, in (i), the distributor both adds nothing to the truth conditions.

(i) John and Mary both arrived.

One possibility, raised by the audience at LAGB 2015, is that dou and both are used as contrast focus in comparison
(37) [John and Mary] **dou** arrived.
   a. LF: **dou** C [S [John and Mary][+s] arrived]
   b. [S] = arrive(j ⊕ m)
   c. C = \{ arrive(x) | x, is a relevant individual \}
   d. Sub([S], C) = \{ arrive(j), arrive(m) \}
   e. \[dou_C(S)] = arrive(j ⊕ m) \land ¬O[\text{arrive}(j)] \land ¬O[\text{arrive}(m)] = arrive(j ⊕ m)

In contrast, in (38), it is ungrammatical to associate **dou** with an atomic proper name John (unless John is stressed): regardless of the context, the prejacent clause has no sub-alternative, failing to satisfy the non-vacuity presupposition of **dou**.15

(38) [John] (*dou) arrived.

5. Deriving the uses of **dou**

5.1. Deriving the quantifier-distributor use

Recall that, when used as a quantifier-distributor, **dou** has no effect on the truth-conditions of an assertion, but it evokes three requirements: (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 have a non-atomic interpretation. This section will focus on the latter two requirements. (For a rough idea regarding to the “maximality requirement”, see footnote 14.) I will argue that these two requirements are both illusions. Moreover, I will show that all the facts that are thought to be results of these two requirements are simply logical consequences of the non-vacuity presupposition of **dou**.

5.1.1. Explaining the “distributivity requirement”

To generate sub-alternatives and satisfy the non-vacuity presupposition of **dou**, the prejacent of **dou** has to be logically stronger than some of its alternatives. In the case that the associate of **dou** is one of the non-maximizers like only part of or only one of: If this is the case, the question under discussion for (37) and (i) would be ‘is it the case that John and Mary both arrived or that only one of them arrived?’ This idea is supported by the distribution of stress discussed in section 2.4: when **dou** functions as a quantifier-distributor, stress can only be assigned to the particle **dou**, not to the associate of **dou**. Moreover, this idea also explains the maximality requirement of **dou** under the quantifier-distributor use. Let me sketch out this idea informally: the assertion of the **dou**-sentence (ii) (repeated from (2)) is identical to the inference in (iiia), which is tolerant of non-maximality; but (ii) also implicates the anti-non-maximality inference (iiib), giving rise to a maximality requirement.

(ii) (Scenario: The children, with only one or two exceptions, went to the park.)

[Haizimen] [daou] qu -le gongyuan.

children dou go -PERF park

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

(iii) a. The children went to the park.
   b. Not [only part of the children went to the park.]

15The sentence (38) would be grammatical if the associate of **dou** is stressed. However, in this case, **dou** would have an even-like reading, not function as a quantifier-distributor. For discussions on the relation between these two uses of **dou**, see section 6.


dou is an entity (of type e), this requirement is satisfied only when the predicate denoted by the remnant VP is (atomically or non-atomically) distributive or divisive.

Consider (39) for illustration. For simplicity, I follow the well-known cover-based treatment of generalized distributivity by Schwarzschild (1996), ignoring its problems in generating alternatives. To disambiguate, this section uses C for the cover variable and CF-Alt for the set of contextually relevant F-alternatives that dou quantifies over. The prejacent clause of dou is interpreted as in (39a), where a generalized distributor Part distributes over the contextually determined cover of a ⊕ b ⊕ c. Alternatives of the prejacent clause are derived by replacing a ⊕ b ⊕ c with a contextually relevant individual, as in (39b). Sub-alternatives are (roughly) the ones formed based on the sum of a proper subset of C, as in (39c).}

(39) **Dou** C-Alt [ S a ⊕ b ⊕ c bought houses]
   a. [S] = PartC(f, a ⊕ b ⊕ c)
   b. CF-Alt = {PartC(f, x) | xe is relevant}
   c. Sub([S], CF-Alt) = {PartC(f, x) | xe is relevant and ∃C' ⊂ C [x = ⊕ C']}

The quantification domain of dou is illustrated in the following. For simplicity, I ignore alternatives based on individuals that are not parts of a ⊕ b ⊕ c. Shading marks sub-alternatives, box encloses the prejacent proposition, and arrows indicate entailment relations. If C is non-singleton, the prejacent clause of dou has an atomic/non-atomic distributive reading and does have some weaker/sub-alternatives, which therefore satisfies the non-vacuity presupposition of dou. In contrast, if the prejacent clause takes a collective/single-cover reading, it does not have a weaker/sub-alternative, making dou undefined.

(39 cont.) **Quantification domain of dou:**

\[ C_{F-Alt} = \begin{cases} \text{Part}_C(f, a \oplus b \oplus c) \\ \text{Part}_C(f, a) & \text{Part}_C(f, a \oplus b) & \text{Part}_C(f, a \oplus c) \\ \text{Part}_C(f, b) & \text{Part}_C(f, b \oplus c) \\ \text{Part}_C(f, c) \end{cases} \]

---

16 In the alternatives, the value of C always equals the contextually determined cover of the associated item in the prejacent (viz., the cover of a ⊕ b ⊕ c), and Part only distributes over C. (See Liao 2011: chap. 4.) For example, if C = {a, b, c}, the alternative PartC(f, d) is vacuously a tautology (namely, it is true if f holds for every subpart of d that is in {a, b, c}), and the alternative PartC(f, a ⊕ b ⊕ c ⊕ d) is logically equivalent to PartC(f, a ⊕ b ⊕ c). These consequences are harmless for now. However, problems arise in cases involving an operator that operates on excl-alternatives. For example, to derive the exhaustification inference of (i), the alternative ‘d bought houses’ should not be a tautology.

(i) Only abc bought houses. ∼→ d didn’t buy houses.

See a solution in Liu (2016c) based on Link-Landman’s approach to encoding distributivity/collectivity distinction. Details regarding to Liu’s formal implementations are omitted due to the scope of this paper.

17 For reasons discussed in footnote 16, in the cover-based account of distributivity, it does not matter if x contains parts that are not members of C. Thus, more accurately, the set of sub-alternatives should be formulated as follows:

(i) Sub([S], CF-Alt) = {PartC(f, x) | xe is contextually relevant and ⊆ ∪ {y | y ⊆ x ∧ C(y) ⊆ C}}

(An alternative is a sub-alternative iff it is based on a contextually relevant individual x such that some but not every member of C is a subpart of x.)
Non-atomic distributive: If \( C = \{a, b \oplus c\} \), then ...

\[
\begin{align*}
C_{F\text{-Alt}} &= \{f(a) \land f(b) \land f(c)\} \\
&= \left\{ \begin{array}{c}
\text{Part}_{C}(f, a \oplus b \oplus c) \\
\text{Part}_{C}(f, a) \\
\text{Part}_{C}(f, b \oplus c)
\end{array} \right\}
\end{align*}
\]

Collective: If \( C = \{a \oplus b \oplus c\} \), then ...

\[
\begin{align*}
C_{F\text{-Alt}} &= \{f(a \oplus b \oplus c)\} \\
&= \left\{ \begin{array}{c}
f(a) \\
f(b) \\
f(c)
\end{array} \right\}
\end{align*}
\]

In conclusion, the particle \textit{dou} itself is not a distributor, but in certain cases, its non-vacuity presupposition forces the application of a distributor, or the application of an operation that makes the prejacent clause distributive. We can now explain why \textit{dou} can be associated with the distributive expression NP-\textit{gezi} ‘NP-each’. In sentences like (40), the presence of the distributor \textit{gezi} ‘each’ is not redundant; instead, it is required for satisfying the non-vacuity presupposition of \textit{dou}. If \textit{gezi} is not overtly used and the predicate following \textit{dou} is non-distributive in lexicon, there would still be a covert distributor in the sentence.

\begin{enumerate}
\item (40) \textit{Tamen gezi} \textit{dou} you \textit{xie} you\textit{dian}.
   They \textit{each} \textit{dou} have some advantage
   ‘They each \textit{dou} has some advantages.’
\end{enumerate}

This account also explains why \textit{dou} can occur in some collective sentences: \textit{dou} can combine with a collective predicate as long as this collective predicate is divisive.

\begin{enumerate}
\item (41) A predicate \( P \) is \textbf{divisive} \iff \( \forall x [P(x) \rightarrow \forall y \leq x[y \in \text{Dom}(P) \rightarrow P(y)]] \)
   (Whenever \( P \) holds of something \( x \), it also holds of every subpart of \( x \) defined for \( P \).)
\end{enumerate}

For instance, \textit{dou} is compatible with divisive collective predicates such as \textit{shi pengyou} ‘be friends’, \textit{jihe} ‘gather’, and \textit{jiamian} ‘meet’, as seen in (42a-c). Consider (42a) for example. Let \textit{tamen} ‘they’ denote the sum of three individuals \( abc \). The set of sub-alternatives is \{\( ab \) \textit{are} \textit{friends}, \( bc \) \textit{are} \textit{friends}, \( ac \) \textit{are} \textit{friends}\}. Applying \textit{dou} yields inference that \( abc \) are friends, not only \( ab \) are friends, not only \( bc \) are friends, and not only \( ac \) are friends. In comparison, \textit{dou} cannot be applied to a collective statement if the predicate is not divisive, as shown in (42d).

\begin{enumerate}
\item (42) \begin{enumerate}
\item [Tamen] \textbf{(dou)} shi pengyou.
   \textit{They} \textit{dou} \textit{be} friends
   ‘They are (all) friends.’
\item [Tamen] \textbf{(dou)} zai dating jihe -le.
   \textit{They} \textit{dou} \textit{at} \textit{hallway} gather -\textit{ASP}
   ‘They (all) gathered in the hallway.’
\item [Tamen] \textbf{(dou)} jian-guo-mian -le.
   \textit{They} \textit{dou} \textit{see}-\textit{EXP}-\textit{face} -\textit{ASP}
   ‘They (all) have met.’
\end{enumerate}
\end{enumerate}
d. [Tamen] (*dou) zucheng-le zhe-ge weiyuanhui.
   they DOU form -ASP this-CL committee
   ‘They (*all) formed this committee.’

5.1.2. Explaining the “plurality requirement”

The “plurality requirement” says that the associate of *dou* has to have a non-atomic interpretation. I argue that this requirement is also illusive, and that the related facts all result from the non-vacuity presupposition of *dou*.

On the one hand, the plurality requirement is unnecessary. In a basic declarative, *dou* can be associated with an atomic item as long as the predicate it combines with is divisive. For instance, in (43a), *dou*’s associate *na-ge pingguo* ‘that apple’ is atomic. With a divisive predicate $\lambda x. John \text{ ate } x$, the prejacent clause of *dou* does have sub-alternatives formed based on proper subparts of *that apple*, as schematized in (44a), which fulfills the non-vacuity presupposition of *dou*. In contrast, in (43b), the predicate $\lambda x. John \text{ ate half of } x$ is not divisive, and hence the prejacent of *dou* has no sub-alternative, as shown in (44b), which makes the presence of *dou* deviant.

(43) a. Yuehan ba [na-ge pingguo] (dou) chi -le.
   John BA that-CL apple DOU eat -PERF
   ‘John ate that apple.’

   John BA that-CL apple DOU eat -PERF one-half
   Intended: ‘John ate half of that apple.’

(44) a. $John \text{ ate that apple} \Rightarrow John \text{ ate } x (x < \text{ that apple})$
   $\text{Sub} (John \text{ ate that apple}) = \{John \text{ ate } x \mid x < \text{ that apple}\}$

b. $\lnot John \text{ ate half of that apple} \Rightarrow John \text{ ate half of } x (x < \text{ that apple})$
   $\text{Sub} (John \text{ ate half of that apple}) = \emptyset$

On the other hand, the plurality requirement is insufficient. When used in a simple declarative with a divisive collective predicate, *dou* requires its associate to denote a group consisting of at least three distinct individuals, as exemplified in (45).

(45) [Tamen -sa/*-lia] dou shi pengyou.
   they -three/-two dou be friends
   ‘They three/*two are all friends.’

The non-vacuity presupposition of *dou* also accounts for this fact. The proper subparts of a dual-individual (e.g., $a \oplus b$) are atomic, which are undefined for the collective predicate *be friends*. Hence in (45), if the associate of *dou* denotes a dual-individual, the prejacent clause of *dou* has no sub-alternative, which yields a presupposition failure.

5.2. Deriving the FCI-licenser use

The particle *dou* can license the FCI use of pre-verbal polarity items, *wh*-items, and disjunctions. In this section, I will show that the assertion of *dou* turns a disjunctive/existential inference into a conjunctive/universal inference. I will also explain why the licensing of a pre-verbal FCI requires the presence of *dou* and why the licensing of a pre-verbal FC-disjunction is subject to Modal Obviation.
5.2.1. Predicting universal FC inferences

As discussed in section 4.1, a disjunction or existential quantifier that carries a [+d] feature is associated with a set of D-alternatives. Thus in the disjunctive sentence (6b), paraphrased in English as in (46), the quantification domain of dou is the set of the D-alternatives of its disjunctive prejacent, as in (46c). Sub-alternatives of the prejacent are the disjuncts, as in (46d). Applying dou affirms the prejacent and negates the exhaustification of each disjunct, yielding a ∀-FC inference, as computed in (46e). In a word, dou turns a disjunction into a conjunction. Crucially, contrary to the derivation of the quantifier-distributor use, here dou does have an effect on the truth conditions, because the prejacent disjunction does not entail the anti-exhaustification inference.

(46) [John or Mary] dou can teach Intro Chinese.
   a. LF: douC [s [John or[+d] Mary] can teach Intro Chinese] (To be revised in (64))
   b. [S] = ⊙φj ∨ ⊙φm
   c. C = D-Alt(S) = {⊙φj, ⊙φm, ⊙φj ∨ ⊙φm}
   d. Sub([S], C) = {⊙φj, ⊙φm}
   e. [douC(S)] = [⊙φj ∨ ⊙φm] ∧ ¬O_C⊙φj ∧ ¬O_C⊙φm
      = [⊙φj ∨ ⊙φm] ∧ [⊙φj → ⊙φm] ∧ [⊙φm → ⊙φj]
      = [⊙φj ∧ ⊙φm]
      = ⊙φj ∧ ⊙φm

This analysis extends to other pre-verbal FCIs. Chierchia and Liao (2015) assume that Mandarin renhe ‘any’-phrases and wh-phrases in non-interrogative sentences are ∃-quantifiers with a [+d] feature. Adopting this view, we can derive the FCI uses of pre-verbal renhe/wh-expressions in the same way as we assumed for pre-verbal disjunctions.

A problem arises as to why disjuncts count as sub-alternatives of disjunctions. In (35) in section 4.3, sub-alternatives are weaker alternatives by the regular definition of excludability. In (46), however, the disjuncts are stronger than the disjunction, how come they are sub-alternatives of the disjunction? This problem is solved once we allow a minimal change from “(non-)excludability” to “(non-)innocent excludability,” a notion coined by Fox (2007) for deriving FC inferences via exhaustification. As schematized in (47a), an alternative is innocently (I)-excludable iff it is included in every maximal set of alternatives A such that affirming the prejacent is consistent with negating all the alternatives in A.18 In (46), the disjuncts are not I-excludable relative to the disjunction: affirming the disjunction and negating both of its disjuncts yield a contradiction. (Formally, let φx abbreviate for the proposition x teaches Intro Chinese, we have {⊙φj, ⊙φm} ⊆ ∪ {⊙φj ∨ ⊙φm} is inconsistent, because [⊙φj ∨ ⊙φm] ∧ ¬⊙φj ∧ ¬⊙φm = ⊥.) Hence, by the definition in (47b) based on innocent (I)-excludability, disjuncts of a disjunction are indeed sub-alternatives of this disjunction.

(47) a. Innocently (I)-excl-alternatives (Fox 2007)

\[ \text{IExcl}(p, C) = \bigcap \{ A \mid A \text{ is a maximal subset of } C \text{ such that } \{ \neg q \mid q \in A \} \cup \{ p \} \text{ is consistent} \} \]

18Another commonly seen definition of I-excl-alternatives is as in (i), which is however inadequate. For example, in sentence “EVERY student came,” where the prejacent is the strongest among the alternatives and thus has no excl-alternative, the condition underlined in (i) is vacuously satisfied; therefore, the definition in (i) predicts that every alternative of p is I-excludable, which is apparently implausible.

(i) \[ \text{IExcl}(p, C) = \{ q \mid q \in C \land \neg \exists p' \in \text{Excl}(p, C)\![p \land \neg q] \rightarrow q' \} \]

(The set of alternatives q such that affirming p and negating q does not entail any excl-alternatives)
(The intersection of the maximal sets of alternatives of $p$ in $C$ such that the exclusion of each such maximal set is consistent with $p$.)

b. **Sub-alternatives** (Based on innocent excludability)

\[
\text{Sub}(p, C) = (C - \text{IExcl}(p, C)) - \{p\}
\]

(The set of alternatives excluding the I-excl-alternatives and the prejacent itself)

Weaker alternatives are clearly not I-excludable: affirming a prejacent and negating a weaker alternative yield a contradiction. Hence, in cases where the associate of *dou* has no D-alternative, the I-excludability-based definition of sub-alternatives in (47b) and the regular excludability-based definition in (35) predict the same set of sub-alternatives.

The following is an interim summary for the semantics of *dou*:

(48) **Semantics of *dou* (Interim)**

\[
\lbrack *dou_C \rbrack = \lambda p \lambda w : \exists q \in \text{Sub}(p, C). p(w) = 1 \land \forall q \in \text{Sub}(p, C)[OC(q)(w) = 0]
\]

where \(\text{Sub}(p, C)\) is defined as in a or b:

a. Def strong (Based on regular excludability)

\[
\text{Sub}(p, C) = (C - \text{Excl}(p, C)) - \{p\}
\]

b. Def weak (Based on innocent excludability)

\[
\text{Sub}(p, C) = (C - \text{IExcl}(p, C)) - \{p\}
\]

Compare the two definitions of sub-alternatives: Def strong is only compatible with the quantifier-distributor use of *dou*, while Def weak also extends to the FCI-licenser use. This contrast gives us two ways to view the definition of sub-alternatives.

(i) **The unifying view.** Sub-alternatives are uniformly defined based on I-excludability. Def strong is just a special case where the I-excl-alternatives are excludable.

(ii) **The weakening view.** Sub-alternatives are primarily defined based on regular excludability. Def weak is available only when non-excludability is weakened to non-I-excludability. This weakening operation is licensed only when the associate of *dou* carries a [+d] feature.

The unifying view predicts that the quantifier-distributor use and the FCI-licenser use are both primary, while the weakening view predicts that the FCI-licenser use is derived from the quantifier-distributor use. I argue that the weakening view is more preferable to the uniform view. First, empirically, the quantifier-distributor use of *dou* emerged as early as the Eastern Han Dynasty (25-220 A.D.) (Gu 2015), while the other uses came much later. Second, theoretically, the uniform view cannot explain the alternation between the *even*-like use of *dou* and the other two uses — the *even*-like use can be easily derived by weakening Def strong, but not by a simple change to Def weak. I will return to this point in section 6.

### 5.2.2. Licensing conditions of Mandarin FCIs: Facts

In English, an *any*-phrase is licensed as a \(\forall\)-FCI when it precedes a possibility modal (e.g., *can*), but not licensed when it appears in an episodic sentence or before a necessity modal, as shown in (49). The phenomenon that a possibility modal licenses a pre-verbal \(\forall\)-FCI is called **Modal Obviation**.

(49) a. Any guest *can/*must come in.

b. * Any guest came in.
It is crucial to differentiate between pre-verbal and post-verbal FCIs. First, appearing pre-verbally or post-verbally, some FCIs yield different truth conditions. Take Mandarin *shenme*-NP for example. (50a) is true only if every relevant individual has a possibility of being seen by John; while (50b) allows exceptions. Therefore, we consider pre-verbal *shenme*-NP a $\forall$-FCI while post-verbal *shenme*-NP an $\exists$-FCI which allows partial variation.\(^{19}\)

(50) a. Yuehan *shenme-ren dou* keneng jian-guo
   John   what-person *dou* perhaps meet-exp
   Intended: ‘Everyone is such that John might have seen him/her.’

b. Yuehan keneng jian-guo *shenme-ren.
   John   perhaps meet-exp what-person
   Intended: ‘Perhaps John has met someone. [I don’t know which.]’

Second, even in cases where a post-verbal FCI yields the same truth conditional meaning as its pre-verbal counterpart, they are subject to different licensing conditions. Compare (49a) with (51-52). A post-verbal *any*-NumP/NP yields a universal inference if it is embedded under a possibility modal, as in (52a)/(51a). However, in contrast to a pre-verbal *any*-phrase, a post-verbal *any*-NumP can also be licensed in the presence of a necessity modal, as in (51b). A simple *any*-NP cannot appear directly under a necessity modal, but it can occur in a supplementary construction, as in (52b) (Dayal 2004).

(51) a. John can read any two books.
   b. John must read any two books.

(52) a. John can read any book.

As for disjunctions, it is widely known that post-verbal disjunctions can function as FCIs when embedded under a modal (Alonso-Ovalle 2005; Fox 2007; Santorio and Romoli 2017; among others).

(53) a. You can invite Andy or Billy.
   $\sim$ You can invite Andy and you can invite Billy.

b. You must invite Andy or Billy.
   $\sim$ You can invite Andy and you can invite Billy; you must invite one of them.

Mandarin post-verbal disjunctions behave the same as above. But strikingly, Mandarin pre-verbal disjunctions can also function as $\forall$-FCIs in the presence of *dou*. Moreover, the licensing of this use is subject to Modal Obviation (Xiang 2016b).

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

b. [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.’

\(^{19}\)For discussions on partial variation, see Fălăuş (2009, 2014) on Romanian *vreun*, Alonso-Ovalle and Menéndez-Benito (2010) on Spanish *algun*, and Chierchia (2013) on Italian *un qualche* and *un N qualsiasi*.\)
To license the $\forall$-FCI use of a pre-verbal $wh$-expression or a polarity item (e.g., $\text{renhe}$ ‘any’-NP), $\text{dou}$ also must be present. But the licensing conditions related to Modal Obviation are quite unclear. For example, Giannakidou and Cheng (2006) claim that the bare $wh$-word $\text{shei}$ ‘who’ can be licensed as a $\forall$-FCI in an episodic $\text{dou}$-sentence like (55a). This distributional pattern, however, is very unproductive: the other episodic $\text{dou}$-sentence (55b) sounds very odd. Hence, there must be some salvaging effect from the experiential maker $\text{-guo}$ on FCI-licensing. I leave this puzzle open.

(55) a. [Shei] $\text{dou}$ jiao -guo jichu hanyu.
   who $\text{dou}$ teach -exp intro Chinese.
   ‘Everyone has taught Intro Chinese.’

b. ?? [Shei] $\text{dou}$ jinlai -le.
   who $\text{dou}$ enter -asp.
   Intended: ‘Everyone came in.’

The licensing conditions of pre-verbal $\text{na}$-cl-NP ‘which-NP’ and $\text{renhe}$-NP ‘any-NP’ are even harder to generalize. Giannakidou and Cheng (2006) claim that the $\forall$-FCI use of these items are only licensed in a pre-$\text{dou}$+$\odot$ position. Their judgements are illustrated in (56). Nevertheless, it is difficult to make generalizations about the grammaticality of these sentences because judgements on (56) vary greatly among native speakers.

(56) a. [Na-ge/Renhe -ren] $\text{dou}$ keyi/??bixu jinlai.
   which-cl/any -person $\text{dou}$ can/must enter
   Intended: ‘Everyone can/must come in.’

b. ?? [Na-ge/Renhe -ren] $\text{dou}$ shou dao -le yaoqing.
   which-cl/any -person $\text{dou}$ get arrive -asp invitation
   Intended: ‘Everyone got an invitation.’

Given the individual variations in grammaticality judgments and the unproductiveness of pre-verbal $\forall$-FCIs in sentences without a possibility modal, I neglect the licensing conditions of $\forall$-FCI uses of Mandarin $wh$-/any-expressions related to Modal Obviations. For recent studies on Mandarin $\forall$-FCIs, see Liao 2011, Cheng and Giannakidou 2013, and Chierchia and Liao 2015.

In summary, the licensing of Mandarin $\forall$-FCIs is subject to (at least) two conditions. First, to license the $\forall$-FCI use of a pre-verbal $wh$/any-expression, $\text{dou}$ must be present and be associated with this $wh$/any-expression. Second, the licensing of the $\forall$-FCI use of a pre-verbal disjunction is subject to Modal Obviation and requires the presence of a post-$\text{dou}$ possibility modal. The following two sections explain these two conditions. The Modal Obviation effect in the licensing of the $\forall$-FCI use of a preverbal $wh$/any-expression is yet unclear and will not be discussed.

5.2.3. The role of $\text{dou}$ in licensing FCIs

This section explains why in Mandarin the presence of $\text{dou}$ is mandatory in a declarative containing a pre-verbal $wh$/any-expression. Following Chierchia and Liao (2015), I assume that the sub/D-alternatives associated with a Mandarin $wh$/any-expression are obligatorily activated when this expression has a non-interrogative use, and that these sub/D-alternatives must be used up via employing a c-commanding exhaustifier. Hence, if the particle $\text{dou}$ is absent, these sub/D-alternatives would be have to be used by a basic O-exhaustifier, as in (57b). In what follows, I will show that the application of a basic O-exhaustifier has an undesired semantic consequence.
(57) [Shei] *(dou) can teach Intro Chinese.
   a. The LF in the presence of dou:  dou\_C [shei\_\(+d\)] can teach Intro Chinese
   b. The LF in the absence of dou:  O\_C [shei\_\(+d\)] can teach Intro Chinese

Compare the computation in (58) with (46). In (46), applying dou to a disjunction returns a conjunction, yielding a FC inference. While in (58), applying a basic O-exhaustifier to a disjunction affirms this disjunction and negates both of its disjuncts, yielding a contradiction and making the wh-declarative ungrammatical.

(58) Consider only two relevant individuals a and b:
   a. \[S] = \Diamond \phi_a \lor \Diamond \phi_b \quad S = \text{‘shei\_\(+d\) can teach Intro Chinese’}\n   b. \[C = \text{D-Alt}(S) = \{\Diamond \phi_a, \Diamond \phi_b, \Diamond \phi_a \lor \Diamond \phi_b\}\n   c. \text{Excl}(\[S], C) = \text{Sub}(\[S], C) = \{\Diamond \phi_a, \Diamond \phi_b\}\n   d. \[\text{O}_C(S) = (\Diamond \phi_a \lor \Diamond \phi_b) \land \neg \Diamond \phi_a \land \neg \Diamond \phi_b = \bot\n
The case of disjunctions is slightly different. Unlike those of wh/any-items, the sub-alternatives of disjunctions are not mandatorily activated (Chierchia 2006, 2013). Hence, in the absence of dou, a sentence with a pre-verbal disjunction has a simple (inclusive or exclusive) disjunctive interpretation.

The explanation above faces a challenge: why it is that the sub-alternatives of a wh-declarative cannot be used by a covert pre-exhaustification exhaustifier, such as the O\_oo\_operator proposed by Xiang (2016c) and Xiang (2016: chap. 2) for interpreting mention-some questions? I argue that the covert O\_oo\_operator cannot be placed here due to a fundamental principle for the architecture of human languages, roughly, “Language-particular choices win over universal tendencies” or “Don’t do covertly what you can do overtly.” (Chierchia 1998) We consider an exhaustification over the sub-alternatives of a polarity item as a grammatical operation. Given that dou must be associated with a preceding item in most declaratives, we predict the following distributional pattern of overt and covert dou, illustrated by the polarity item renhe ‘any’:\n\n(59) a. Ni [renhe-ren] *(dou) keyi jian.  
   \quad You any-person dou can meet.
   \quad ‘Anyone is such that you can meet with.’
   b. \textcolor{red}{*dou} /\textcolor{red}{*O}_{oo} [anyone; you can meet with ti]

(60) a. Ni *(dou) keyi jian [renhe-ren].  
   \quad You \textcolor{red}{dou} can meet any-person
   \quad ‘You can meet with anyone.’
   b. \textcolor{red}{*dou} /\textcolor{red}{*O}_{oo} [you can meet with anyone]

If a renhe-phrase appears in or can be overtly raised to a pre-verbal position, the sub-alternatives of this renhe-sentence can be exhaustified by the overt particle dou, which therefore blocks the use of the covert O\_oo\_operator, as in (59). In contrast, when exhaustification cannot be done by dou due to other syntactic constraints (such as that dou in general cannot be associated with an

\textit{20}No matter whether the FCI takes scope above or below the possibility modal, applying dou/O\_oo yields the same truth conditions, as shown in the following computation:

\begin{align*}
\text{(i) a. } & \text{dou}(\Diamond p \lor \Diamond q) = (\Diamond p \lor \Diamond q) \land \neg \Diamond \Diamond p \land \neg \Diamond \Diamond q = \Diamond p \lor \Diamond q & \text{For pre-verbal FCI} \\
\text{b. } & O_{oo}(\Diamond (p \lor q)) = (\Diamond (p \lor q)) \land \neg \Diamond \Diamond p \land \neg \Diamond \Diamond q = \Diamond p \lor \Diamond q & \text{For post-verbal FCI}
\end{align*}
item appearing on its right side), a covert pre-exhaustification exhaustifier would be feasible, as in (60). In short, since dou is Mandarin-particular, the covert O_dou-operator cannot be used whenever the overt particle dou can be used.

5.2.4. Modal obviation of licensing pre-verbal FC-disjunctions

Modal Obviation has been discussed extensively in the realm of exhaustification theories. Representative works include Dayal (2009), Menéndez-Benito (2010), Chierchia (2013), and Dayal (2013). I will first show that the former three analyses do not extend to disjunctions, because they involve assumptions incompatible with the semantics of disjunctions. Next, I will introduce the Variability Constraint (Dayal 2013) and adapt it to a compositional analysis.

Dayal (2009) proposes a Fluctuation Constraint: in an any-sentence of the form [any NP VP], the intersection of the restriction (i.e., NP) and the scope (i.e., VP) which verifies the sentence should not be constant across the accessible worlds. This analysis defines pre-verbal any as a $\forall$-quantifier and thus does not extend to disjunctions. Menéndez-Benito (2010) uses local exhaustification to explain the Modal Obviation effect in licensing Spanish cualquiera. Her analysis, which defines a FCI as a simple predicate and derives the FC inference via a propositional $\forall$-quantifier, is also incompatible with the lexical meaning of the disjunctive. I will not dive into the details of these two analyses. For a review, see Chierchia (2013: section 6.6).

Chierchia (2013) defines any-phrases uniformly as $\exists$-indefinites and derives $\forall$-FC inferences via a mechanism of exhaustification similar to (46). His explanation of the Modal Obviation effect is two fold. First, he assumes that an any-phrase evokes a scalar implicature (SI). The episodic sentence (61) is ungrammatical because its SI contradicts the $\forall$-FC inference.

(61) *Anyone came.
   FC: Everyone came.
   SI: Not everyone came.

For modalized sentences, Chierchia (2013) assumes that FC and SI are assessed relative to different modal bases $M_{fc}$ and $M_{si}$. In the presence of a possibility modal, the contradiction between FC and SI can be rescued if $M_{si} \subset M_{fc}$.

This analysis also does not extend to $\forall$-FC disjunctions. It relies on the relation between FC inferences and SIs and has to assume that SIs are mandatory, but SIs of disjunctions are optional.

As seen in (62a), a disjunctive episodic sentence does not not trigger a SI if it serves as the antecedent of a conditional. Despite of the absence of SIs, in (62b), associating dou with the contained pre-verbal disjunction makes the sentence ungrammatical. In conclusion, the failure of licensing a pre-verbal FC-disjunction has nothing to do with SIs.

21 For illustration, let the domain of anyone be \{a, b\}, the predicted inferences are as in (i) and (ii). If $M_{fc} = \{w_1, w_2, w_3\}$ and $M_{si} = \{w_1, w_2\}$, the two inferences in (i) are not contradictory — both inferences are true if $\phi_a$ is true only in $w_1$ and $\phi_b$ is true only in $w_3$. In contrast, the two inferences with necessity modals in (ii) are contradictory regardless of the modal containment relation. Hence, possibility modals can obviate the ungrammaticality but necessity modals cannot.

(i) Consistent if $M_{si} \subset M_{fc}$
   FC: $\diamond_{M_{fc}} \phi_a \land \diamond_{M_{fc}} \phi_b$
   SI: $\neg[\diamond_{M_{si}} \phi_a \land \diamond_{M_{si}} \phi_b]$

(ii) Contradictory even if $M_{si} \subset M_{fc}$
   FC: $\Box_{M_{fc}} \phi_a \land \Box_{M_{fc}} \phi_b$
   SI: $\neg[\Box_{M_{si}} \phi_a \land \Box_{M_{si}} \phi_b]$

22 In Xiang (2016b), I provided a different analysis of Modal Obviation. This analysis also attributes the obviation effect to a syncategorematic treatment of SIs in modalized contexts and problematically requires mandatory SIs.
   If John or Mary teach-perf Intro Chinese, I then not-worry
   ‘If John or Mary (but not both) has taught Intro Chinese, I won’t be worried’

   b. *Ruguo [Yuehan huoze Mali] dou jiao-le jichun yanyu, wo jiu
      If John or Mary do teach-perf Intro Chinese, I then
      not-worry

Compared with the aforementioned three accounts, Dayal (2013) has the greatest potential
to extend to Mandarin pre-verbal FC-disjunctions. This account assumes FCI to be lexically
existential and does not require SIs. These assumptions are compatible with the semantics of
disjunctions. For Modal Obliviation, Dayal (2013) proposes a Viability Constraint: every exhausti-
ﬁed alternative is true relative to a modal base made up of a subset of the accessible worlds. This
constraint is unsatisﬁed in episodic sentences immediately since there is no modal base to start
with. For modalized any-sentences, with two relevant individuals a and b and a modal base M,
their FC inferences and viability conditions are schematized as in (63). The two formulas for the
◇-sentence (63a) are consistent. For example, both formulas are true if M = \{w1, w2, w3\} and
f = \{\langle w1, \{a\}\rangle, \langle w2, \{b\}\rangle, \langle w3, \{a, b\}\rangle\}. (The pair \langle w1, \{a\}\rangle is read as ‘only a comes in w1.’) In
contrast, the two formulas for the □-sentence (63b) are contradictory: for any modal M such that
□Mf(a) is true, □M[f(b) ∧ ¬f(a)] is false.

(63) a. Anyone can come.
   FC: □Mf(a) ∧ □Mf(b) (f stands for the property came)
   Viability: □M[f(a) ∧ ¬f(b)] ∧ □M[f(b) ∧ ¬f(a)]

   b. *Anyone must come.
   FC: □Mf(a) ∧ □Mf(b)
   Viability: □M[f(a) ∧ ¬f(b)] ∧ □M[f(b) ∧ ¬f(a)]

The Viability Constraint yields desired predictions but is syncategorematic and quite ad
hoc. In what follows, I offer a compositional analysis that reaches similar results. I assume that
the disjunctive ◇-sentence (54a) has the LF in (64). Compared with the LF in (46a), the only
difference is that here the modal verb mandatorily embeds a covert O-exhaustiﬁer, which checks
off the [+f] feature of the VP-internal trace of the pre-verbal disjunction.23 This LF yields a FC
inference.24

23This assumption was originally proposed by Xiang (2016c,a) for interpreting questions (such as where can we get
gas?) that are ambiguous between mention-some readings and mention-all readings. Since mention-some questions
contain a possibility modal, and their disjunctive answers receive FC interpretations, it is not surprising that this
analysis extends to the Modal Obliviation effect in the licensing of ∀-FCIs.

24Chierchia (2013: section 6.6.1) argues that the locally exhaustiﬁed FC inference is too strong. This argument
was ﬁrst made against the local exhaustiﬁcation approach by Menéndez-Benito (2010) but also applies to Dayal
(2013) and the presented analysis. For example, composed with a local exhaustiﬁer, the ﬁrst clause of (i) means
◇OqF ∧ ◇qF ∧ ◇qF (qF stands for ‘you invite x’), which requires the possibility of inviting exactly one person
and contradicts the second clause. This problem extends to other pre-verbal ∀-FCIs.

(i) [Andi Bili huo Xiind] ni dou keyi qing, dan ni bixu qing qizhong zhishao liang-ge-ren.
   Andy Billy or Cindy you dou can invite, but you must invite among least two-cl-person
   ‘You can invite Andy, Billy, or Cindy. But you must invite at least two of them.’

Anna Szabolcsi (pers. comm.) points out a related challenge. Consider the following sentence:

(ii) Any student can sit next to another student.

The relation sit next to is symmetric: student x sits next to student y iff y sits next to x. As such, any exhaustiﬁed
sentence of the form ‘O [xF sits next to a student]’ is a contradiction. I leave this issue open.
5.3. Deriving the scalar operator use

There are two cases where dou functions as a scalar operator. One is in a [(lian) Foc dou...] construction, where dou is associated with the preceding (lian)-Foc and evokes an even-like inference. The other case is where dou is associated with an in-situ scalar item. This section starts with the semantics of English even (section 5.3.1) and then derives the even-like reading of dou in the [(lian) Foc dou...] construction based on the proposed semantics of dou (section 5.3.2). Section 5.3.3 explains the minimizer-licensing effect of the [(lian) Foc/Min dou...] construction. Section 5.3.4 extends to cases where dou is associated with an in-situ scalar item.

5.3.1. The semantics of even

The English scalar particle even is sensitive to focus. As seen in (66), associating even with different focus yields different comparative inferences.

(66) a. Mary even introduced BILL_F to Sue.
   ⇝ Compared with Mary introducing (some of) the others to Sue, it is unlikely/surprising
      that she introduced Bill to Sue.

b. Mary even introduced Bill to SUE_F.
   ⇝ Compared with Mary introducing Bill to (some of) the others, it is unlikely/surprising
      that she introduced Bill to Sue.

Due to the Focus Condition, the domain of even is a subset of F-alternatives of the prejacent clause: [(even_C(S))] is defined only if C \subseteq F-Alt(S). However, unlike the case of only, excludability for the scalar exclusive particle even is defined based on likelihood, not logical strength.

Even is standardly defined as a F-sensitive operator with a vacuous assertion and a scalar presupposition. There are dissenting views on the quantificational force of this scalar presupposition. Karttunen and Peters (1979) assume that this presupposition is universal: it requires that the propositional argument of even is the less likely than all of its contextually relevant F-alternatives (except itself).

(67) Semantics of even (Karttunen and Peters 1979)
In contrast, Bennett (1982) and Kay (1990) argue that the universal scalar presupposition is too strong and thus define an existential scalar presupposition: even presupposes that its propositional argument is less likely than at least one of its contextually relevant F-alternatives.

As shown by the following examples, taken from Kay (1990), even-clauses can describe non-extreme cases. For example, (69a) is felicitous although the prejacent clause of even, namely, Mary made it to the SEMI-finals F, is less extreme than that Mary made it to the finals.

(69) a. Not only did Mary win her first round match, she even made it to the SEMI-finals F.
   b. The administration was so bewildered that they even had [lieutenant colonels] F making policy decisions.

One way to restore the universal scalar presupposition is to assume that the most extreme case, that Mary made it to the finals, is not included in the alternative set used by even (Lahiri 2008; Greenberg 2016, 2019b). Moreover, Greenberg argues against the existential scalar presupposition with examples like (70): even cannot be used in a non-extreme case once the extreme case has been made explicitly in the context.

(70) (Harry, John and Bill participated in the sports competition.) Harry made it to the finals, John won his first round match, and Bill (? even) made it to the SEMI-finals F.

Contra Greenberg (2016, 2019b), I argue that the oddness of even in (70) is not due to the failure of satisfying the scalar presupposition of even. Instead, it is due to the oddness of not using even when the option of using even is clearly available in terms of the truthfulness of the related evaluative inference and the speaker’s linguistic habit of using evaluative particles. More precisely, a conjunction of the form “S1 and even-S2” implicates that either (i) even-S1 is infelicitous (i.e., that the evaluative scalar presupposition, that S1 is unlikely, is false,) or at least that (ii) even-S2 does not grant the felicity of even-S1 (i.e., that S2 is unlikely does not entail that S1 is unlikely). In consequence, if even is used for a less extreme case, it should also be used for the more extreme case(s). For example, in contrast to (70), even felicitously appears in the semi-finals-clause in (71) as it also appears in the finals-clause.

(71) [ — Harry, John and Bill participated in the sports competition. I heard that Harry won his first round. How exciting! — Well,] not only that Harry won his first round, John even made it to the FFinals F, and Bill also even made it to the SEMI-finals F!

The above condition of even-clauses can be descriptively generalized as follows:25

25In an earlier version of this paper, I stated the felicity condition as follows:

(i) For an evaluative expression δ, a coordination with clauses \{p, δ(q)\} is felicitous only if the evaluative inference of δ(p) is false.

Greenberg (2019a) argues that this condition is too strong. In the following example, the utterances by B1 and B2 are
(72) **The felicity condition of coordinating clauses with evaluatives**

For an evaluative expression \( \delta \), a coordination with clauses \( \{ p, \delta(q) \} \) is felicitous only if the evaluative inference of \( \delta(q) \) does not entail the evaluative inference of \( \delta(p) \).

Consider the evaluative word *surprising(ly)* for illustration of this felicity condition. As shown in (73a-b), in a conjunction, modifying one conjunct with *surprising(ly)* but not the other implicates that the conjunct without *surprising(ly)* is not/less surprising.

(73)  

| a. Harry made it to the finals, and Bill (also) made it to the semi-finals.  
| \[ \not \hookrightarrow \text{It is not/less surprising that Harry made it to the finals.} \]  
| b. Harry made it to the finals, and **surprisingly**, Bill (also) made it to the semi-finals.  
| \[ \hookrightarrow \text{It is not/less surprising that Harry made it to the finals.} \]  

The condition (72) also extends to exclusive scalar particles like *only* and *just*, which are pragmatic antonyms of *even* (Klinedinst 2005; Zeevat 2009; Beaver and Clark 2008; Al Khatib 2013; contra Greenberg 2019b). In (74), using *just* triggers an evaluative inference that the speaker considers the said price cheap. It is odd to use *only* for a higher price while not using it for a lower price, as in (74a), compared with (74b).

(74)  

[— How much are these shoes? — Well, ...]  

| a. ... this pair is $40, and that pair is (#**only**) $50.  
| b. ... this pair is **only** $40, and that pair is (**only**) $50.  

In conclusion, the infelicity of the sentence (70) is not due to the failure of the scalar presupposition of *even*. Hence, I adopt the view of Bennett (1982) and Kay (1990) and assume an existential scalar presupposition for *even*.

### 5.3.2. Deriving the *even*-like inference

The [(lian) Foc dou ...] construction has an *even*-like reading. I assume a toy surface structure as in (75). Details of tense and aspect are ignored. In this structure, *dou* serves as a VP-adjunct, and *lian* is a focus marker which takes the focused or focus-containing phrase as its complement. To check off the [+EPP] feature of *dou*, *lian* together with the focused phrase (or the focus-containing phrase) moves to the spec of FP.

Both felicitous, despite that the evaluative inference of *Bill only wrote 5*, namely that writing 5 papers is not well, is true.

(ii)  

A: How many papers did your faculty members write in this period?  
B<sub>1</sub>: Well, John did great. He wrote 8 papers. The rest didn't do so well: Bill wrote 5, and Susan **only** wrote 4.  
B<sub>2</sub>: Well, John did great. He wrote 8 papers. The rest didn't do so well: Bill wrote 5, **Harry only** wrote 3 and Susan **only** wrote 4.  
(Modified from Greenberg (2019a: ex. 26))

The modified felicity condition (72) correctly predicts the felicity of these utterances — that writing 4 papers is not well does not entail that writing 5 papers is not well.

It is also worth mentioning that, as far as vagueness and subjectivity are considered, the seemingly stronger condition (i) actually makes the same prediction as (72). If ‘being well’ vaguely means writing \( n \) or more papers, *only wrote m papers* presupposes \( m < n' \), where \( n' \) is a subjectively chosen number that can be equivalent to, or slightly less than, or much less than the actual threshold \( n \). Hence in (ii), although it is true that writing 5 papers is not well (\( 5 < n \)), *Bill wrote 5* may not be modified by **only** as long as the chosen \( n' \) is not larger than 5. In contrast, if the speaker uses **only** for the clause *Bill wrote 5*, then the chosen \( n' \) must be larger than 5, making **only** mandatory in *Susan wrote 4*. This argumentation also applies to the examples in (74).
The above two changes adapt the semantics of the above computation shows that a weaker proposition as follows: "Even the team leader was late."

For the purpose of this paper, we can ignore this special case by strengthening the non-vacuity presupposition as

when dou is associated with lian-FocP, the measurement used for ordering alternatives gets shifted from logical strength to likelihood. As a logical consequence, this shift changes both the meaning of sub-alternatives and the meaning of the exhaustifier encoded within the lexicon of dou used for pre-exhaustification. First, a proposition that is logically weaker is usually more likely to be true, and thus sub-alternatives of the prejacent propositional argument of dou are the alternatives that are more likely than this prejacent proposition. Second, the pre-exhaustification effect of dou is realized by the scalar exhaustifier just (not the O-exhaustifier). In analogy to the O-exhaustifier, just affirms the prejacent and states a scalar exhaustivity condition that no true alternative is more likely.

Sub-alternatives as more likely alternatives (By likelihood)

\[ \text{Sub}(p, C) = \{ q \mid q \in C \land q \geq \text{likely} \ p \} \]

\[ \text{just}_C(q) = w : q(w) = 1 \land \forall r \in C \{ r(w) = 1 \rightarrow q \leq \text{likely} r \} \]

(q is true, and q is the least likely proposition among its true alternatives in C.)

The above two changes adapt the semantics of dou to (78). Compared with the default semantics defined in (48), the only thing that gets changed is the semantics of sub-alternatives, or more specifically, the measurement for ordering alternatives.

Semantics of dou (in the [liang Foc dou ...] construction)

26 It is yet unclear what triggers the shift of the ordering source. One possibility is that the shift to likelihood is licensed by accenting the associate of dou. Cross-linguistically, associates of conv like particles are emphatic.

27 This generalization is a lax variant of the Entailment-Scalarity Principle (Crnič 2011: 15): for any two propositions p and q, if p \subseteq q, then p \leq \text{likely} q. Strictly speaking, a proposition logically weaker than p can have the same probability as p. By Kolmogorov's third axiom, the probability of a union of mutually exclusive propositions equals the sum of the probability of the propositions. Formally: for any two propositions p_1 and p_2, if p_1 \cap p_2 = \emptyset, then Pr(p_1 \cup p_2) = Pr(p_1) + Pr(p_2). Accordingly, we have:

(i) If p \subseteq q, then Pr(q) = Pr(p \cup (q - p))

\[ = Pr(p) + Pr(q - p) \leq Pr(p) \]

The above computation shows that a weaker proposition q and the stronger proposition p are equally possible if their difference q - p is assigned possibility zero, which amounts to saying that p and q are contextually equivalent.

(ii) Two propositions p and q are contextually equivalent with respect to context c iff \forall w [w \in c \rightarrow p(w) = q(w)].

For the purpose of this paper, we can ignore this special case by strengthening the non-vacuity presupposition as follows: "dou(S)" is defined only if S has a sub-alternative in C and that this sub-alternative is not contextually equivalent to S. I thank Benjamin Spector and Manuel Križ for discussions. All errors are mine.

28 The O-to-just change is a logical consequence of redefining sub-alternatives as more likely alternatives:

(i) \[ O_C(q) = \lambda w : q(w) = 1 \land \forall r \in ((C - \text{Sub}(q, C)) - \{ q \})[r(w) = 0] \]

\[ = \lambda w : q(w) = 1 \land \forall r \in ((C - \{ r' \mid r' \in C, r' > \text{ likely} q \}) - \{ q \})[r(w) = 0] \]

\[ = \lambda w : q(w) = 1 \land \forall r \in C[r < \text{ likely} q \rightarrow r(w) = 0] \]

\[ = \lambda w : q(w) = 1 \land \forall r \in C[r(w) = 1 \rightarrow q \leq \text{likely} r] \]

\[ = \text{just}_C(q) \]
I define existential scalar presupposition of dou in the focal position of the \( \text{lian Foc dou...} \) construction. Following Rooth (1985, 1992, 1996), we say that a focused or native that is more likely than some true alternative of \( p \) is entailed by the rest of the asserted part that ‘\( p \) is true.’ [Proof: If \( q \) is a more likely alternative of \( p \), \( p \) is a less likely alternative of \( q \). Hence, whenever \( p \) is true, any \( q \) that is a more likely alternative of \( p \) has a true alternative \( p \) which is less likely than \( q \). End of proof.] Hence, the asserted component of \( \text{dou} \) simply affirms its propositional argument, or equivalently, is vacuous. Finally, we get a \( \text{dou} \) semantically equivalent to \( \text{even} \): the non-vacuity presupposition of \( \text{dou} \) is equivalent to the existential scalar presupposition of \( \text{even} \), and the operator \( \text{dou} \) does not affect the assertion.

\[
[dou_C] = \lambda p \lambda w : \exists q \in \text{Sub}(p, C).p(w) = 1 \land \forall q \in \text{Sub}(p, C)[\text{just}_C(q)(w) = 0]
\]

(For any proposition \( p \): \( [dou_C](p) \) is defined only if \( p \) has at least one sub-alternative in \( C \). When defined, \( [dou_C](p) \) means ‘\( p \), and for any sub-alternative \( q \) in \( C \), not just \( q \).’)

In the likelihood-based semantics, the assertion of \( \text{dou} \) can be further simplified. The anti-exhaustification condition provided by the not just-clause (underlined in (79)) that ‘every alternative that is more likely than \( p \) is more likely than some true alternative of \( p \),’ is entailed by the rest of the asserted part that ‘\( p \) is true.’ [Proof: If \( q \) is a more likely alternative of \( p \), \( p \) is a less likely alternative of \( q \). Hence, whenever \( p \) is true, any \( q \) that is a more likely alternative of \( p \) has a true alternative \( p \) which is less likely than \( q \). End of proof.] Hence, the asserted component of \( \text{dou} \) simply affirms its propositional argument, or equivalently, is vacuous. Finally, we get a \( \text{dou} \) semantically equivalent to \( \text{even} \): the non-vacuity presupposition of \( \text{dou} \) is equivalent to the existential scalar presupposition of \( \text{even} \), and the operator \( \text{dou} \) does not affect the assertion.

\[
[\text{even}_C]
\]

Thus, it is plausible to say that the even-like interpretation of the [lian Foc dou ...] construction comes from the non-vacuity presupposition of \( \text{dou} \) (Portner 2002, Shyu 2004, Paris 1998, Liao 2011, Liu 2016c), while that the particle lian is simply a focus marker and is present just for syntactic purposes. I define lian as follows: it asserts the meaning of its argument, and presupposes that this argument is focused. Following Rooth (1985, 1992, 1996), we say that a focused or focus-containing expression \( \alpha \) has at least one F-alternative distinct from itself.

\[
[\text{lian}](\alpha) = [\alpha], \text{defined only if } \{[\alpha]\} \subset F\text{-Alt}(\alpha).
\]

### 5.3.3. Minimizer-licensing

Minimizers (including also emphatic weak scalar items such as YI-ge ren ‘ONE person’) can occur in the focal position of the [lian Foc dou...] construction. In most cases, to license a minimizer, a post-\( \text{dou} \) negation must be present, as exemplified in (81). However, there are also cases where the post-\( \text{dou} \) negation is optional, as in (82).

(81) Yuehan (lian) [YI-ge ren]F [dou] *(bu) renshi.
John lian one-cl person dou neg know
‘John does not know anyone.’

(82) Yuehan (lian) [YI-fen qian]F [dou] (bu) yao.
John lian one-cent money dou neg want
With negation: ‘John does not even want one cent.’ (\( \approx \) ‘John does not want any money.’)
Without negation: ‘John wants it even if it is just one cent.’ (\( \approx \) ‘John wants any amount of money; however small amount it is.’)
Minimizers must occur under a non-upward-entailing (i.e., downward-entailing or non-monotonic) operator. An operator is upward-entailing if it preserves the entailment pattern of its argument, downward-entailing if it reverses this pattern, and non-monotonic if it does neither. For instance, the entailment from *Li is a syntactician* to *Li is a linguist* is preserved in the modalized sentences (83a) and reversed in the negative sentences (83b). We thus say that *might* is upward-entailing while *not* is downward-entailing. In comparison, neither direction of entailment holds in the bi-conditional sentences (83c), which suggests that the bi-conditional connective *iff* is non-monotonic in its second argument.

(83) a. **Upward-entailing**  
   Li might be a linguist.  
   \[\uparrow\]  
   Li might be a syntactician.  

b. **Downward-entailing**  
   Li isn’t a linguist.  
   \[\downarrow\]  
   Li isn’t a syntactician.  

C. **Non-monotonic**  
   I’ll invite Li if she is a linguist.  
   \[\upharpoonup\]  
   I’ll invite Li if she is a syntactician.

In what follows, I show that the distributional pattern of Mandarin minimizers in [lian Foc dou ...] constructions mirrors the distributional pattern of English minimizers and emphatic weak scalar items in *even*-sentences. Next, I extend Crnič (2011, 2014)’s analysis of minimizer-licensing in English *even*-sentences to minimizer-licensing in Mandarin [lian Foc dou ...] constructions.

I. Minimizer-licensing in *even*-sentences: scalar presupposition + operator movement

In English, a minimizer (such as a canonical minimizer like *lift a finger* or an emphatic weak scalar item like *ONE video*) can be associated with *even* only if the propositional complement of *even* is downward-entailing or non-monotonic with respect to this minimizer (Crnič 2011, 2014). Consider the distribution of the emphatic weak scalar item *ONE video* in *even*-sentences for illustration. It is licensed only if the *even*-sentence involves a downward-entailing operator such as negation *n’t*, as in (84b), or a non-monotonic predicate such as the desire predicate *hope*, as in (84c).

(84) a. * John made even ONE video.
    b. John didn’t make even ONE video.
    c. I hope to someday make even ONE video of that quality.

Crnič (2011, 2014) argues that the distribution of minimizers in *even*-sentences is a consequence of the scalar presupposition of *even*. For his analysis, it does not matter whether the scalar presupposition is universal or existential. I present his idea with an existential scalar presupposition. Further, Crnič bridges logical strength and likelihood via the following principle (see also footnote 27):

(85) **Entailment and Scal arity** (Crnič 2011: 15)
    If \( p \subseteq q \), then \( p \leq_{\text{likely}} q \).
    (If a proposition \( p \) entails a proposition \( q \), then \( p \) is at most as likely as \( q \).)

Conversely, if \( p >_{\text{likely}} q \), then \( p \not\subseteq q \). Therefore, to satisfy an existential scalar presupposition, the propositional prejacent of *even* must have an alternative that does not entail the prejacent. This requirement immediately predicts the ungrammaticality of (84a). With a focus-mark on the weak scalar item *ONE*, alternatives in the domain of *even* are formed by replacing *ONE* with other positive integers: \( C = \{ \text{John made } n \text{ videos} \mid n \in \mathbb{N}^+ \} \). Hence, the existential scalar presupposition of *even* requires the prejacent proposition to be more likely than, and thus not entailed by, at least one of the alternatives in \( C \). Nevertheless, because the prejacent is entailed by
all the alternatives in $C$, this requirement cannot be satisfied, leaving the use of *even* infelicitous and the minimizer unlicensed.

(86) *John made even ONE video.
   a. Even$_C$ [John made one$_{[+f]}$ video]
   b. For any $n$ s.t. $n > 1$: John made $1$ video $\supset$ John made $n$ videos

As for the grammatical sentences in (84b-c), Crnič proposes that the LFs of these sentences involve a covert movement of *even*. This movement does not leave a trace, but it makes *even* take wide scope. When *even* is associated with a minimizer across a downward-entailing operator (e.g., *not*) as in (87a), the prejacent is logically stronger than all the other alternatives. When *even* is associated with a minimizer across a non-monotonic operator such as the desire predicate *hope* (Heim 1992) as in (88a), the prejacent is logically independent from other alternatives.  

(87) John didn’t make even ONE video.
   a. Even$_C$ [DE not [even$_C$ [John made one$_{[+f]}$ video]]]
   b. For any $n$ s.t. $n > 1$: not [John made $1$ video] $\subset$ not [John made $n$ videos]

(88) I hope to someday make even ONE video of that quality.
   a. Even$_C$ [NM I hope to [even$_C$ [someday make one$_{[+f]}$ video of that quality]]]
   b. For any $n$ s.t. $n > 1$: I hope to [... make $1$ video ...] $\not\subseteq$ I hope to [... make $n$ videos ...]
   I hope to [... make $1$ video ...] $\not\supset$ I hope to [... make $n$ videos ...]

II. Minimizer-licensing in [lian ... dou ...] constructions: scalar presupposition + F-reconstruction

Similar to the minimizer-licensing condition in English *even*-sentences, in Mandarin, the minimizer in a [lian ... dou ...] construction is licensed iff the prejacent clause is downward-entailing or non-monotonic with respect to this minimizer. Briefly, the post-*dou* negation *bu* in (81) provides a downward-entailing environment, while the desire predicate *yao* ‘want’ in (82) provides a non-monotonic environment.

Since the Mandarin particle *dou* in a [lian ... dou ...] construction is semantically equivalent to English *even*, we can easily extend Crnič’s analysis of minimizer-licensing in English *even*-sentences to minimizer-licensing in Mandarin [lian ... dou ...] constructions. Briefly, the minimizer-licensing condition is a logical consequence of the non-vacuity presupposition of *dou*, which requires the propositional argument of *dou* to be less likely than at least some of the alternatives, and hence not to be the weakest among the alternatives. The only difference between my treatment of *dou* and Crnič’s treatment of *even* is the following: while Crnič assumes an operator movement of *even* over a non-upward-entailing operator, I assume that the minimizer undergoes reconstruction and gets interpreted below a non-upward-entailing operator.

In (81), repeated below, the non-vacuity presupposition of *dou* forces the minimizer YI-ge ren ‘ONE person’ to undergo reconstruction and be interpreted below negation. Hence, in the

29 A reviewer points out a problem with Crnič’s analysis: if the LF of the sentence (88) were as in (88a) where *even* moves covertly to the left edge, the following sentence would be grammatical, contra fact.

(i) #I even hope to someday make ONE video of that quality.
absence of negation or if the minimizer scopes above negation, the propositional argument of *dou* would be logically the weakest among its alternatives, leaving the non-vacuity presupposition of *dou* unsatisfied.

(89) Yuehan (lian) [YI-ge ren] *dou* *(bu) renshi.
  John [LIAN one-CL person *dou* NEG know
  ‘John does not even know ONE person.’
  a. *DouC [UE [lian (one[+] person)]] not [John knows tᵢ]]
     for any n > 1: ∃₁x⁻[know(j, x)] ⊃ ∃nx⁻[know(j, x)]
  b. DouC [DE not [John knows [lian (one[+] person)]]]
     for any n > 1: ¬∃₁x[know(j, x)] ⊂ ¬∃nx[know(j, x)]

The F-reconstruction analysis is supported by the ungrammaticality of (90): a minimizer cannot be licensed if it cannot be reconstructed to a position below negation (or other non-upward-entailing operator). In (90), the minimizer *YI*-ge ren ‘ONE person’ serves as the subject, whose surface position and reconstructed position are both higher than negation *bu*, and hence the ungrammaticality of (90) cannot be salvaged by F-reconstruction.³⁰

(90) *(Lian) *YI-ge ren* dou bu renshi Yuehan.
  LIAN one-CL person *dou* NEG know John.
  Intended: ‘No one knows John.’

The optional presence of a post-*dou* negation in (82) can be accounted for in the same way. The desire predicate *yao* ‘want (to have)’ is a non-monotonic operator (after Heim 1992). Hence, when the minimizer *YI*-fen qian ‘ONE cent’ takes scope below *yao*, as in (91b), the alternatives of the propositional argument of *dou* are semantically independent from each other. In a context such as that John is unlikely to be interested in a small amount of money, the prejacent *John wants to have one cent* would be less likely than alternatives such as *John wants to have two cents*. Therefore, the non-vacuity presupposition of *dou* can be satisfied even without the presence of post-*dou* negation.

(91) a. Yuehan (lian) [YI-fen qian] *dou* *yao*.
  John [LIAN one-cent money *dou* want
  ‘John wants to have even one cent.
  (Intended: John wants any money, however little money it is.)’
  b. DouC [NM John] *wants to* [[lian (one[+] cent)]] λx [ei have x]]

5.3.4. Association with a scalar item

Associating *dou* with an in-situ scalar item implies that the prejacent proposition ranks relatively high with respect to the contextually relevant measurement. A simple thought would be to order the alternatives based on the contextually relevant measurement, and to define the sub-

³⁰Mandarin is highly isomorphic. It does not allow scope inversion at least for subjects. For example:

(i) a. Mei-ge-ren *dou* mei lai.
  every-CL-person *dou* NEG come
  (*every ≫ NEG, NEG ≫ every)  
  b. You yi-ge-ren mei lai.
  exist one-CL-person NEG come
  (*some ≫ NEG, NEG ≫ some)
alternatives as the ones that rank lower than the prejacent proposition with respect to this measurement.\textsuperscript{31}

(92) \textbf{Sub-alternatives as lower ranked alternatives} (by contextually relevant measurement)
\[
\text{Sub}(p, C) = \{ q \mid q <_{\mu} p, q \in C \}
\]
(The set of contextually relevant alternatives of \( p \) that rank lower than \( p \) w.r.t. \( \mu \))

In (93), repeated from (9), sub-alternatives are propositions that rank lower than the prejacent in chronological order. The sentence means that it’s 5 o’clock, not just 4 o’clock, not just 3 o’clock, and so on.

(93) \textbf{Dou} [WU-f-dian] -le.
\textbf{dou} five-o’clock -ASP
‘It is already FIVE o’clock.’ \( \sim \) \textit{It’s too late.}
\begin{enumerate}
\item \( C = \{ \text{it’s } n \text{ o’clock} \mid n \in \mathbb{N}, 0 \leq n \leq 24 \} \)
\item \( \text{Sub}(\text{it’s five o’clock}, C) = \{ \text{it’s 4 o’clock, it’s 3 o’clock, ...} \} \)
\end{enumerate}

When \textit{dou} agrees with the \([+\sigma]\) feature of a scalar item, to satisfy the non-vacuity presupposition of \textit{dou}, the prejacent scalar clause needs to be relatively strong among its \( \sigma \)-alternatives. For example, in (94), \textit{dou} can be associated with ‘twice’ but not with ‘once’.

(94) \textbf{Ta} \textbf{dou} yiijing \textbf{lai} -guo zher [LIANG/*YI-ci] -le.
\textbf{he dou} already come -exp here two/one-time -ASP.
‘He has already been here twice/*once.’

6. \textbf{Sorting the parameters}

In sum, I have defined \textit{dou} uniformly as pre-exhaustification exhaustifier that negates pre-exhaustified sub-alternatives, as repeated from (33). This semantics derives the three uses of \textit{dou}. For the distributor use and the scalar marker use, the non-vacuity presupposition is responsible for all the observed semantic effects, while the anti-exhaustivity inference collapses under the prejacent inference. For the FC-licenser use, the non-vacuity presupposition is trivially satisfied, while the prejacent inference together with the anti-exhaustivity inference yields the FC inference.

\begin{equation}
[dou_C] = \lambda p \lambda w : \exists q \in \text{Sub}(p, C) \cdot p(w) = 1 \land \forall q \in \text{Sub}(p, C) [O_C(q)(w) = 0]
\end{equation}

I have also shown that the alternations in function of \textit{dou} come from the minimal variations in defining sub-alternatives. Among the four variants for the definition of sub-alternatives summarized in Table 1, the first two are based on logical strength, varying with respect to the type of excludability (regular excludability or innocent excludability), the third is based on likelihood, and the last is based on a contextually determined scale. This section considers only the first three variants.

\textsuperscript{31}See Greenberg (2018, 2019b) for a refined analysis of English \textit{even} that makes use of general gradability instead of likelihood. Her analysis also extends to the Mandarin particle \textit{dou}.
Definition of sub-alternatives

<table>
<thead>
<tr>
<th>Definition of sub-alternatives</th>
<th>Function of <strong>dou</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Def (a) Alternatives that are <strong>weaker</strong> than the prejacent</td>
<td>Distributor</td>
</tr>
<tr>
<td>Def (b) Alternatives that are <strong>not I-excludable</strong></td>
<td>∀-FCI-licenser</td>
</tr>
<tr>
<td>Def (c) Alternatives that are <strong>more likely</strong> than the prejacent</td>
<td><strong>EVEN</strong></td>
</tr>
<tr>
<td>Def (d) Alternatives ranked lower than the prejacent w.r.t. a relevant measurement</td>
<td>Scalar marker</td>
</tr>
</tbody>
</table>

Table 1: Definitions of sub-alternatives and the corresponding functions of **dou**

Here arise two non-trivial questions: how are these variants of definitions of sub-alternatives related, and which of these variants is primary? I argue that Def (a) is primary, and that Def (b-c) are derived from Def (a) by two independent semantic weakening operations, as illustrated in Figure 1.

(b) Not I-excludable (c) More likely
(a) Weaker / Not excludable

Figure 1: Development path for sub-alternatives

In particular, Def (b) is derived from Def (a) by weakening non-excludability to non-I-excludability: any non-excludable alternative is also non-I-excludable, while not all excludable alternatives are I-excludable. Def (c) is derived from Def (a) by shifting from logical strength to likelihood: in general, a weaker alternative is less likely. (See footnote 27.) As seen in section 5.3.3, in consequence, the non-vacuity presupposition gets weakened from requiring the existence of a weaker alternative to requiring the existence of a non-entailing alternative, which can be either weaker than or logically independent from the prejacent.

The proposed derivational path for sub-alternatives yields two predictions. First, the distributor use of **dou** is primary, while the other two uses are derived, as illustrated in Figure 2. This prediction is supported by diachronic evidence: the two derived uses emerged much later than the primary use. In particular, the distributor use of **dou** emerged as early as the Eastern Han Dynasty (25-220 A.D.) (Gu 2015), while so far there is no reliable evidence to show that **dou** could function as an even-like scalar operator or a FCI-licenser before the Ming Dynasty (1368-1644 A.D.).

(b) FCI-licenser (c) **EVEN**
(a) Distributor

Figure 2: Development path for the uses of **dou**

Second, the likelihood-based semantics of **dou** (i.e., the semantics based on Def (a) of sub-alternatives) is marked and can be less widely used than the logical strength-based semantics (i.e., the semantics based on Def (c) of sub-alternatives). More concretely, the proposal predicts that the logical strength-based semantics of **dou** is default and should be widely available, and that the likelihood-based one is derived and should be marked with further syntactic or
prosodic operations. This prediction is supported by the synchronic distribution of *dou* in basic declaratives and in \([\text{lian} \ldots \text{dou} \ldots]\) constructions. The following table summarizes this distribution, broken up into three cases by the logical strength of the prejacent proposition of *dou* relative to its alternatives. The critical case is Case C, where the prejacent of *dou* is neither stronger than any alternative nor is the weakest alternative. In this case, *dou* can be used in a \([\text{lian} \ldots \text{dou} \ldots]\) construction but not in a basic declarative. This distribution gap shows that the distributor use of *dou* does not come from the likelihood-based semantics, and that the likelihood-based semantics is not the default semantics.

<table>
<thead>
<tr>
<th>If the prejacent of <em>dou</em> is ...</th>
<th>Can the non-vacuity presupposition of <em>dou</em> be satisfied in ...</th>
</tr>
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<tbody>
<tr>
<td>A. stronger than some alternative(s)</td>
<td>Yes</td>
</tr>
<tr>
<td>B. the weakest alternative</td>
<td>No</td>
</tr>
<tr>
<td>C. neither</td>
<td>No</td>
</tr>
</tbody>
</table>

**Table 2: Distribution of *dou* in declaratives and \([\text{lian} \ldots \text{dou} \ldots]\) constructions**

In what follows, I will explain the three cases one by one. Keep in mind that *dou* presupposes the existence of a weaker alternative under the logical strength-based semantics, and the existence of a more likely alternative under the likelihood-based semantics.

**Case A:** When the prejacent of *dou* is logically stronger than one or more of its alternatives, the non-vacuity presupposition of *dou* is satisfied under both the logical strength-based and the likelihood-based definitions. For example, in (96a-b), compared with the prejacent *John can eat up three bowls of rice*, alternatives such as *John can eat up two bowls of rice* are weaker and more likely than the prejacent. The logical strength-based semantics yields the quantifier-distributor use of *dou* in (96a), where stress falls on the particle *dou*. The likelihood-based semantics yields the *even*-like use of *dou* in (96b).33

(96) a. Yuehan \([\text{zhe} \text{san-wan} \text{ fan}] \text{DOU} \text{chi-de-wan}.\]
   *John \text{DEM} \text{three-bowl} \text{rice} \text{DOU} \text{eat-mod-finish}*
   ‘John can eat up \text{(these) three bowls of rice}.’

   b. Yuehan \([\text{lian}] \text{SAN}_f \text{-wan} \text{ fan}] \text{dou} \text{chi-de-wan}.
   *John \text{LIAN} \text{three-bowl} \text{rice} \text{dou} \text{eat-mod-finish}*
   ‘John can even eat up \text{THREE bowls of rice}.’

**Case B:** When the prejacent of *dou* is logically weaker than all the other alternatives, *dou* suffers a presupposition failure in both semantics. For example, as in (97a), *dou* cannot be associated with the non-emphatic phrase ‘(this) one person’ when it functions as a quantifier-distributor, because the prejacent proposition is the logically weakest alternative. Likewise, as in the \([\text{lian} \ldots \text{dou} \ldots]\) sentence (97b), in the absence of a non-upward-entailing operator, *dou* cannot be associated with an emphatic phrase *YI-ge ren ‘ONE person’ and function as an *even*-like minimizer-licenser, because the prejacent proposition of *dou* is the logically weakest as well as the most likely among its alternatives.

---

32For the same reason, the proposal predicts that the non-excludability-based semantics of *dou* (i.e., the one defined based on definitions (b) of sub-alternatives) is more restrictedly used than the logical strength-based one. For example, the non-excludability-based semantics is licensed only when *dou* is associated with an existential or disjunctive quantifier.

33There is a subtle difference between the two examples in (96): *san-wan fan* ‘three bowls of rice’ receives a referential interpretation in the basic declarative (96a) but a generic interpretation in the \([\text{lian} \ldots \text{dou} \ldots]\) sentence (96b).
    John this one/three-cl person dou know
    ‘John knows all the *one/three people.’

b. Yuehan (lian) [YL-ge ren] dou *(bu) renshi.
    John LIAN one-cl person dou NEG know
    ‘John does*(n’t) even know ONE person.’

Case C: When the prejacent sentence is neither stronger than any of its alternatives nor is the weakest among its alternatives, the two semantics of dou yield a contrast with respect to the truth/falsehood of the non-vacuity presupposition — the logical strength-based semantics yields a presupposition failure, but the likelihood-based semantics may not. For example, the sentence JOHN\textsubscript{f} arrived cannot be logically weaker than any of its alternatives (i.e., propositions of the form x\textsubscript{e} arrived); but there are cases where this sentence is more likely than some of its alternatives. The contrast in grammaticality between (98a-b) confirms this prediction: the sentence JOHN\textsubscript{f} arrived can serve as the prejacent in a [(lian) Foc dou ...] construction as in (98b) where stress falls on the focal element, but not in a basic declarative as in (98a) where stress is assigned to the particle dou. The reason for this contrast is that the likelihood-based semantics, which allows sub-alternatives to be logically independent from the prejacent, has a narrower distribution than the logical strength-based semantics. The licensing condition of the likelihood-based semantics is yet unclear; one possibility is that the switch from logical strength to likelihood is licensed by accenting the associate of dou. In contrast, if the logical strength-based semantics were primary and were available across the board, the sentence (98a) would also be grammatical and would be interpreted as an even-inference, contra fact.

    John DOU arrive-perf
    ‘John (*all) arrived.’

b. (Lian) [YUEHAN\textsubscript{f}] dou dao-le.
    LIAN John DOU arrive-perf
    ‘Even JOHN\textsubscript{f} arrived.’

A similar argument can be constructed based on the contrast between (99a-b). Although both sentences are grammatical, the prejacent clause they bought houses admits a collective reading in the [(lian) Foc dou ...] sentence (99b) but not in the basic declarative (99a). When taking a collective reading, the prejacent of dou is logically independent from all the alternatives, but it can be more likely than some of its alternatives in proper contexts. The unavailability of collective readings in (99a) again shows that dou cannot be interpreted with a likelihood-based semantics when appearing in a basic declarative.

(99) a. Tamen DOU mai-le fangzi.
    They DOU buy-perf house
    ‘They dou bought houses.’ (#collective, √distributive)

b. (Lian) [TAMEN\textsubscript{f}] dou mai-le fangzi.
    LIAN they DOU buy-perf house.
    ‘Even THEY bought houses.’ (√collective,√distributive)
7. Conclusions

This paper offered a uniform semantics to capture the seemingly diverse functions of the Mandarin particle *dou*, including the quantifier-distributor use, the $\forall$-FCI-licenser use, and the scalar operator use. I define *dou* as 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.

The semantics of *dou* has minimal alternations caused by semantic weakening operations on the definition of sub-alternatives, giving rise to different uses. By default, sub-alternatives are the alternatives that are weaker than the prejacent, or equivalently, the ones that are not excludable and distinct from the prejacent. Under this definition of sub-alternatives, *dou* obtains its primary use as a distributor. Further, with a weakening from non-excludability to non-I-excludability, *dou* gains its FCI-licenser use. Alternatively, with a weakening from logical strength to likelihood, *dou* becomes semantically equivalent to English *even* and functions as a scalar operator. The derivational path for the functions of *dou* is supported by both diachronic and synchronic evidence.

The anti-exhaustivity assertion of *dou* is responsible for the derivation of FC inferences. The non-vacuity presupposition of *dou* explains the distributional pattern of *dou* and many of its semantic consequences, such as the requirements regarding to distributivity and plurality, the *even*-like interpretation of the [lian Foc/Min *dou* ...] construction, the distributional pattern of the post-*dou* negation in licensing minimizers, and so on.

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Appendix A: Deriving FC with recursive exhaustification

Readers who are familiar with the grammatical view of exhaustification might find that the proposed meaning of *dou* is similar to the operation of recursive exhaustification proposed by Fox (2007) or to the pre-exhaustification exhaustifier for D-alternatives by Chierchia (2013). This appendix reviews the possibility of using recursive exhaustification to derive the $\forall$-FCI use
of a pre-verbal disjunction in Mandarin. For a detailed comparison of these three operators, especially on computing sentences with post-verbal FCIs, see Xiang (2016a: chap. 2 Appendix).

Fox’s (2007) recursive exhaustification (abbreviated as ‘O\(^R\)) has two major characteristics. First, exhaustification negates only alternatives that are I-excludable. Second, exhaustification is applied recursively. See (100) for a concrete example for computing the meaning of a \(\Diamond\)-sentence with a post-verbal FCI. The inner exhaustification negates the I-excludable sub-alternative would not be negated by expect: if the exhaustification of a sub-alternative is still not innocently excludable, the exhaustification of this sentence to be recursively exhaustified and be turned into a conjunction.

For an easier comparison with dou, I schematize the semantics of \(O\(^R\) as in (101): \(O\(^R\) affirms the prejacent, negates the exhaustification of each sub-alternative, and negates the I-excl-alternatives.\(^{34}\)

\[
\begin{align*}
(100) & \textbf{Recursive exhaustifications} (\text{Fox 2007}) \\
& O\(^R\Diamond [p \lor q] \\
& a. \text{The first exhaustification:} \\
& O\Diamond [p \lor q] = \Diamond (p \lor q) \land \neg \Diamond (p \land q) \land \neg \Diamond r \\
& b. \text{The second exhaustification:} \\
& O'O\Diamond [p \lor q] = O\Diamond (p \lor q) \land \neg O\Diamond (p) \land \neg O\Diamond (q) \\
& = [\Diamond (p \lor q) \land \neg \Diamond (p \land q) \land \neg \Diamond r] \land [\Diamond p \rightarrow \Diamond q] \land [\Diamond q \rightarrow \Diamond p] \\
& = [\Diamond (p \lor q) \land \neg \Diamond (p \land q) \land \neg \Diamond r] \land [\Diamond p \leftrightarrow \Diamond q] \\
& = \Diamond p \land \Diamond q \land \neg \Diamond (p \land q) \land \neg \Diamond r
\end{align*}
\]

It is obvious that \(O\(^R\) is stronger than the proposed meaning of dou: unlike \(O\(^R\), dou does not negate I-excl-alternatives and thus does not yield an exclusive inference or a scalar implicature. For instance, the sentence “John or Mary dou can teach Intro Chinese” (English paraphrase of (6b)) does not imply that no one other than John and Mary can teach Intro Chinese. If dou is defined equivalent to \(O\(^R\), we will have to assume that all the I-excludable F-alternatives are pruned.

Two reviewers suggested an alternative way to derive the FCI-licenser use of dou, which attributes the derivation of FC to the application of recursive exhaustification. The idea is as follows. First, dou is vacuous in assertion but it presupposes that the prejacent has at least one weaker alternative, as in (102b). Second, when dou is applied to a disjunctive sentence, since its prejacent is the weakest among its alternatives, its presupposition forces this disjunctive sentence to be recursively exhaustified and be turned into a conjunction.

\[
(102) \ [\text{John or Mary}] \textbf{dou} \text{ can teach Intro Chinese.} \\
a. \text{LF: dou}_C [ \ O\(^R\) [\text{John or Mary can teach Intro Chinese}]] \\
b. [dou_C] = \lambda p \lambda w : \forall q \in C[p \subset q], p(w) = 1 \\
c. \ C = \text{D-Alt(S)} = \{\Diamond \phi_j \lor \Diamond \phi_m, \Diamond \phi_j, \Diamond \phi_m\}
\]

\(^{34}\)In particular cases, the definition for \(O\(^R\) in (101) yields inferences different from what Fox’s proposal would expect: if the exhaustification of a sub-alternative is still not innocently excludable, the exhaustification of this sub-alternative would not be negated by \(O\(^R\) under Fox’s original definition. See details in Xiang (2016a: footnote 38).
precisely, in computing (100b), if the disjuncts are not alternatives of each other, applying the disjunctions do not carry a syntactic domain variable. (See definitions of D-alternatives in (24) and (25).)

However, this analysis also requires D-alternatives to be used twice — once by the local exhaustifier for deriving FC inference, and the other is by dou for fulfilling the presupposition. However, according to the grammatical view of exhaustifications, if an alternative has been used by a local operator, it will become unavailable to global operators. Second, contrary to the expected consequence of this analysis, recursive exhaustification cannot salvage the presupposition failure of dou. Consider the recursively exhaustified alternatives in (102d): these alternatives are derived by applying recursive exhaustification point-wise to the D-alternatives of the prejacent disjunction. The domain for recursive exhaustification, as in (102c), is also the set of D-alternatives of the prejacent disjunction. Hence, although recursively exhaustifying the prejacent disjunction yields a desired FC inference, as in (103a), the recursively exhaustified disjuncts (103b-c) contradict this FC inference, leaving the presupposition of dou unsatisfied.

The alternatives in (102d) are mutually exclusive:

a. \( O^R_C \{ \phi_j \land \phi_m \} = \phi_j \land \phi_m \)

b. \( O^C_R \phi_j = O \phi_j = \phi_j \land \neg \phi_m \)

c. \( O^C_R \phi_m = O \phi_m = \phi_m \land \neg \phi_j \)

One might suggest to solve this problem by stipulating that recursively exhaustifying one disjunct does not negate the other disjunct (for example, let \( O^C_R \phi_j = \phi_j \)). Then, the domain of dou would be pleasantly as follows: \( C' = \{ \phi_j \land \phi_m, \phi_j \lor \phi_m \} \). However, in Fox’s (2007) derivation of \( \exists \)-FC inferences, it is crucial to let disjuncts be alternatives of each other. More precisely, in computing (100b), if the disjuncts are not alternatives of each other, applying the outer exhaustification yields a contradiction. The following considers two possibilities: (104a) assumes that F-alternatives are pruned, while (104b) assumes that F-alternatives (i.e., \( \Diamond_r \) and \( \Diamond_s \)) are not pruned.

(104) a. \( O' O \Diamond [p \lor q] \)
   \( = O \Diamond [p \lor q] \land \neg O \Diamond p \land \neg O \Diamond q \)
   \( = \Diamond [p \lor q] \land \neg \Diamond [p \land q] \land \neg \Diamond p \land \neg \Diamond q \)
   \( = \bot \)

b. \( O' O \Diamond [p \lor q] \)
   \( = O \Diamond [p \lor q] \land \neg O \Diamond p \land \neg O \Diamond q \)
   \( = \Diamond [p \lor q] \land \neg \Diamond [p \land q] \land \neg \Diamond r \lor \Diamond s \land [\Diamond p \rightarrow \Diamond r \lor \Diamond s] \land [\Diamond q \rightarrow \Diamond r \lor \Diamond s] \)
   \( = \Diamond [p \lor q] \land \neg \Diamond [p \land q] \land \neg \Diamond r \lor \Diamond s \land \neg \Diamond p \land \neg \Diamond q \)
   \( = \bot \)

---

35In computing the embedded recursive exhaustification, F-alternatives must be pruned to avoid the undesired exclusive inference. Complications with \( \sigma \)-alternatives are ignored here.

36Crnič (2017) provides an analysis for post-verbal FC-any that overcomes the mutual exclusivity problem. The main trick is that the syntactic domain variable \( D \) of any moves over the recursive exhaustifier, as illustrated in (i). Here, corresponding to the “dou\_C” in (102a), “Op\_C” stands for a F-sensitive operator with a domain \( C' \). (In Crnič 2017, “Op\_C” is a covert even with a universal scalar presupposition.) Thanks to the binding relation between \( D \) and trace \( t_3 \), for each recursively exhaustified alternative, the domain of the recursive exhaustifier varies if \( g(D) \) is replaced with a subset.

(i) \( \text{Op}_C [D \land \text{Op}_C \{ ... \text{any } t_3 \text{ one } ... \}] \)

However, this analysis also requires D-alternatives to be used twice — once by the local exhaustifier, and once by the global focus-sensitive operator. Moreover, it does not extend to FC disjunctions: unlike quantificational determiners, disjunctions do not carry a syntactic domain variable. (See definitions of D-alternatives in (24) and (25).)
Appendix B: Comparing with Liao and Liu

Liao (2011: chap. 4) makes the first attempt to provide a uniform semantics treatment of the three uses of *dou*. Her analysis of the FCI-licenser use is too complex to be reviewed here. Hence, the following introduces only the technicalities in her proposal needed for explaining the scalar operator use and the distributor use. Liao assumes that *dou* has no meaning per se, but that it indicates the existence of focus and is subject to syntactic dependency with a covert c-commanding E-operator, as in (105a). The meaning of this E-operator equals to what Karttunen and Peters (1979) assume for *even*: the E-operator is truth conditionally vacuous but presupposes that its prejacent is the most unlikely proposition among the alternatives.

\[(105) \quad \text{(Lian) } \text{JOHN}_F \text{ dou } \text{arrived.} \]

a. \[E_C [ \text{JOHN}_{[t,i]}, \text{dou } t; \text{ arrived }] \]

b. \[E_C = \lambda p \forall w : \forall q \in C[p \neq q \rightarrow q >_{\text{likely}} p].p(w) = 1 \]

When *dou* applies to a distributive sentence, the scalar presupposition of the E-operator is trivially satisfied: in a distributive reading, the prejacent of *dou* entails all of its alternatives, and hence is not less likely than any of its alternatives.

Liu (2016b,c, 2018) differs from Liao (2011: chap. 4) in two respects. First, instead of placing an E-operator in the logical form, he equates the meaning of *dou* and *even*:

\[(106) \quad \text{Semantics of } \text{dou (Liu 2016b,c, 2018)} \]

\[\text{[dou}_C] = \lambda p \forall w : \forall q \in C[p \neq q \rightarrow p <_{\text{likely}} q].p(w) = 1 \]

This change is advantageous in that it captures the locality of *even*-inferences. In example (107), the *even*-inference is generated within the antecedent *lian* ... *dou* clause and projects over the conditional, as in (107a). If the *even*-inference of a *dou*-sentence were from an E-operator, we would expect the possibility of placing E above the entire conditional (i.e., E [if *lian* *JOHN*_F *dou* came, Mary will be happy]), which however yields the undesired conditional scalar inference in (107b).

\[(107) \quad \text{If } \text{lian } \text{JOHN}_F \text{ dou } \text{came, Mary would be happy.} \]

a. \[\rightsquigarrow \text{Compared with others, JOHN is less likely to come.} \]

b. \[\not\rightsquigarrow \text{Compared with others’ visits, it is more likely that JOHN’s visit would make Mary happy.} \]

Second, based on Link-Landman’s approach to encoding the distributivity-vs-collectivity distinction (Link 1983; Landman 1996, 2012), Liu improves on the treatment of distributivity/collectivity in the derivation of alternatives. (See the problem of cover-based analysis of distributivity/collectivity in footnote 16. Details of Liu’s implementation are omitted due to the scope of this paper.) Liu’s analysis predicts the follows: when having a distributive reading, the propositional argument of *dou* entails all of its alternatives and hence is not less likely than any of its alternatives; when having a collective reading, the propositional argument of *dou* and its alternatives are logically independent, which forces to order the alternatives with respect to likelihood, yielding the *even*-like use of *dou*.

Liu’s account was developed in parallel with the proposed account. For earlier versions, see Xiang 2015, 2016b and Liu 2016a. Although both Liu’s and my accounts use Alternative Semantics, we end up with views contradictory with respect to which function(s) and semantics of *dou* are primary. Briefly, Liu assumes that *dou* is primarily equivalent to the likelihood-based
scalar particle *even*, and that *dou* obtains a distributor-like use when its scalar presupposition is trivially satisfied. In contrast, my account predicts that the *even*-like use of *dou* is secondary: it is employed only when the semantics of sub-alternatives is weakened from logical strength to likelihood. I argue that the prediction of my account is more compatible with the asymmetric distributions of the distributor use and the *even*-like use of *dou* in (98) and (99). If the likelihood-based semantics were the default semantics, *dou* should be licensed whenever the presupposition of its likelihood-based semantics is satisfied, and hence should have the same distribution in basic declaratives and [*lian ... dou ...*] constructions, contra fact. For example, for the basic declarative (108) (English paraphrase of (99a)), if *they bought houses together* is contextually more likely than *the others bought houses together*, the likelihood-based semantics of *dou* should have been defined even if the prejacent takes a collective reading, contra fact.

(108) [They] **DOU** bought houses. (*collective, ok distributor*)

In unpublished communication, Mingming Liu suggested a way to derive the FCI-licenser use of *dou* as follows. When the prejacent proposition of *dou* is existential or disjunctive, the plain value of this prejacent is too weak to satisfy the universal scalar presupposition of *dou*; therefore, the prejacent of *dou* is forced to be recursively exhaustified, giving rise to an FC interpretation. This analysis is similar to what was described in (102) in Appendix A, except that here *dou* presupposes a universal scalar presupposition.

(109) [John or Mary] **dou** can teach Intro Chinese.
   a. **dou**<sub>C</sub> [O<sub>C</sub> John or Mary can teach Intro Chinese]]
   b. [**dou**<sub>C</sub> = λpλw : ∀q ∈ C′[p ≠ q → p <<likely q] . p(w) = 1]

This analysis, however, faces the same problems the recursive exhaustification analysis has, as reviewed in Appendix A. First, it requires the D-alternatives of the prejacent disjunction to be used twice — once by O<sub>R</sub> and once by *dou*. Second, related to the mutual exclusivity problem, this analysis predicts an unwanted scalar inference. *Dou* quantifies over a set of recursively exhaustified D-alternatives, the same as in (103). The scalar presupposition of *dou* is not the wanted trivially true inference (namely, that the FC inference is less likely than both disjuncts), but rather that the FC inference is less likely than both exhaustified disjuncts. Contra the predicted scalar inference, one can coherently say the following: “speaking of John and Mary, it’s unlikely that only John can teach Intro Chinese; it’s more likely that John or Mary **dou** can teach.”

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