Function alternations of the Mandarin particle *dou*: Distributor, free choice licensor, and 'even'

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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 preverbal 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 and not only $S_{A'}$' 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.

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

The "distributivity requirement" says that if a sentence admits both collective and (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 DOU buy -PERF house
'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.
John every-time DOU go 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.
who/ which-CL-person/ any-person DOU can teach intro Chinese
'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]

[2] One 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.'

[3] My 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.
John or Mary can teach intro Chinese
‘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).[4] In the [*lian* Foc *dou* ...] construction, the presence of *lian* is optional, but the associate of *dou* must be stressed.[5]

(7) (Lian) [DUIZHANG$_F$] **dou** chi dao -le.
LIAN team-leader DOU late arrive -ASP
‘Even [the team leader]$_F$ arrived late.’
$\rightsquigarrow$ *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] ‘$\rightsquigarrow$ *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

b. Ta **dou** qu -guo [NANJI$_F$] -le.
he DOU go -EXP Antarctica -ASP
‘He even has been to Antarctica.’

(ii) a. Ta (lian) [XIAOXUE$_F$] **dou** mei shang -guo.
he LIAN primary-school DOU NEG go -EXP

b. Ta **dou** mei shang -guo [XIAOXUE$_F$].
he DOU NEG go -EXP primary-school
‘He hasn’t even 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

(iv) 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

b. Yuehan (lian) [YI$_F$-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.[6]

(9) a. **Dou** [WU$_F$-dian] -le.
DOU five-o'clock -ASP
'It is five o'clock.'
⇝ *It's too late.*

b. Ta **dou** yijing lai -guo zher [LIANG$_F$-ci] -le.
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:

(10) a. [Tamen] **DOU**/**dou** lai -guo liang-ci -le.
they DOU/DOU come -EXP two-time -ASP
'They ALL have been here twice.'

b. (Lian) [TAMEN$_F$] **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.*

c. Tamen **dou** lai -guo [LIANG$_F$-ci] -le.
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.

[6]Note 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.

(i) a. Yuehan **dou** [LAI$_F$] -guo zher yi-ci -le.
John DOU come -EXP here one-CL -ASP
'John has been here once.'

b. Yu **dou** [TING$_F$] -le.
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) **Semantics of** ***dou*** (Lin 1998)
"x dou P" is true iff $\text{PART}_C(P, x) = 1$,
iff $\forall y \in C[y \leq x \rightarrow P(y)]$ where C 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) C is a **cover** of x (written as '$Cov(C, x) = 1$') 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) Possible covers of $a \oplus b \oplus c$ and the corresponding readings of *abc* **dou** bought houses:

$\{a, b, c\}$	Atomic distributive	'*abc* each bought houses'
$\{a \oplus b, c\}$ $\{a \oplus b, b \oplus c\}$ ...	Non-atomic distributive	
$\{a \oplus b \oplus c\}$	Collective	'*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 $Cov(C, x) = 1$, then $[\![dou]\!](x) = |C| > 1 \wedge \exists y \in C[\neg \textsc{Atom}(y) \wedge \forall z \in C[z \leq y]].$
$\iota y \in C[\neg \textsc{Atom}(y) \wedge \forall z \in C[z \leq y]]$
($[\![dou]\!](x)$ 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.)

[7] Champollion (2015) argues that *all* is a distributor that distributes down to subgroups, while that *each* distributes all the way down to atoms.

[8] In (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.

(17) $[\![the]\!](P_{\langle\alpha,t\rangle}) = \exists x_\alpha[x \in P \wedge \forall y \in P[y \leq x]].\iota x_\alpha[x \in P \wedge \forall y \in P[y \leq x]]$
($[\![the]\!](P_{\langle\alpha,t\rangle})$ is defined only if there is a unique maximal object x such that $P(x)$ is true; when defined, the reference of $[\![the]\!](P_{\langle\alpha,t\rangle})$ 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 α is associated with a set of focus (F-)alternatives 'F-$\textsc{Alt}(\alpha)$' (also called the focus value of α 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).

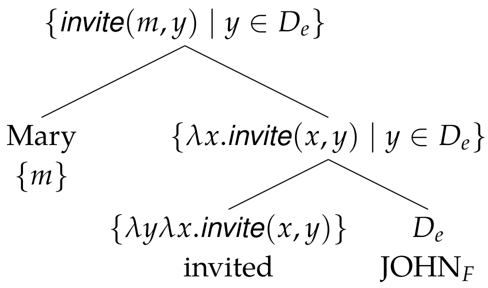
(18) **F-alternatives**

a. For any lexical expression α,
$$\text{F-}\textsc{Alt}(\alpha) = \begin{cases} D_{\text{type}([\![\alpha]\!])} & \text{if } \alpha \text{ is focused} \\ \{[\![\alpha]\!]\} & \text{otherwise} \end{cases}$$

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

The following tree diagram illustrates the composition of F-alternatives. This structure is annotated with the set of F-alternatives at every node.

(19) Mary invited JOHN$_F$.



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.

(20) 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).

(21) a. John *only* introduced BILL$_F$ to Sue.
   ⇝ *John didn't introduce anyone to Sue except Bill.*
   b. John *only* introduced Bill to SUE$_F$.
   ⇝ *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, $[\![only_C(\text{S})]\!]$ is defined only if $C \subseteq$ F-ALT(S).[9] More generally:

(22) **Focus Condition**
For any F-sensitive operator Θ such that Θ quantifies over a domain C and combines with a focus-containing expression δ, $[\![\Theta_C(\delta)]\!]$ is defined only if $C \subseteq$ F-ALT(δ).

In addition to F-alternatives, subsequent works on Alternative Semantics discuss two more types of alternatives, namely, scalar (σ-)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 σ- and D-alternatives are activated by the [+σ] feature and the [+D] feature, respectively. σ-alternatives are derived by replacing the scalar item with meanings belonging to the same scale, as in (23b). D-alternatives of the disjunctive connective

[9] 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 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.

(i) only(C_1) [$\sim C_1$ [$_S$ ... X_F ...]] $[\![\sim C_1(\text{S})]\!] = [\![\text{S}]\!]$, defined only if $[\![C_1]\!] \subseteq$ F-ALT(S) *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, σ-alternatives and D-alternatives grow point-wise.

(23) For any lexical expression α:

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

b. $\sigma\text{-A}\textsc{lt}(\alpha) = \begin{cases} \{\llbracket\alpha_1\rrbracket, ..., \llbracket\alpha_n\rrbracket\} & \text{if } \alpha \text{ carries a } [+\sigma] \text{ feature and } \llbracket\alpha\rrbracket \text{ is part of a scale } \langle\llbracket\alpha_1\rrbracket, ..., \llbracket\alpha_n\rrbracket\rangle \\ \{\llbracket\alpha\rrbracket\} & \text{otherwise} \end{cases}$

(24) For the disjunctive connective *or*:

a. $\text{D-A}\textsc{lt}(or_{[+\text{D}]}) = \{\lambda b\lambda a.a \sqcup b, \lambda b\lambda a.a, \lambda b\lambda a.b\}$

b. $\text{D-A}\textsc{lt}(or_{[-\text{D}]}) = \{\lambda b\lambda a.a \sqcup b\}$

(25) If α_D is a quantifier with a syntactic domain variable D:

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

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.[10] The [+F] feature is assigned to the entire disjunction, while the [+σ] and [+D] features are assigned to the disjunctive connective *or*.

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

b. $\text{F-A}\textsc{lt}([\text{Andy or Billy}]_{[+\text{F}]}) = D_{\langle et,t\rangle}$

c. $\sigma\text{-A}\textsc{lt}([\text{Andy or}_{[+\sigma,\ +\text{D}]}\ \text{Billy}])$
$= \{a^{\Uparrow} \sqcup b^{\Uparrow}, a^{\Uparrow} \sqcap b^{\Uparrow}\} = \{\lambda P.P(a) \vee P(b), \lambda P.P(a) \wedge P(b)\}$

d. $\text{D-A}\textsc{lt}([\text{Andy or}_{[+\sigma,\ +\text{D}]}\ \text{Billy}])$
$= \{a^{\Uparrow} \sqcup b^{\Uparrow}, a^{\Uparrow}, b^{\Uparrow}\} = \{\lambda P.P(a) \vee P(b), \lambda P.P(a), \lambda P.P(b)\}$

---

[10] Disjunctive is interpreted as the join operator '⊔', which must be applied to meanings of the same conjoinable type. The conjunctive *and* is treated as meet '⊓', defined analogously.

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

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

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 $\langle et, t\rangle$ via Montague-lift.

(ii) **Montague lift**
For any meaning α of type τ, the Montague-lifted meaning of α is $\alpha^{\Uparrow}$ such that $\alpha^{\Uparrow} = \lambda m_{\langle\tau,t\rangle}.m(\alpha)$.

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

(iii) $\llbracket\text{Andy or Billy}\rrbracket = a^{\Uparrow} \sqcup b^{\Uparrow}$
$= (\lambda P'.P'(a)) \sqcap (\lambda P'.P'(b))$
$= \lambda P[(\lambda P'.P'(a))(P) \sqcap (\lambda P'.P'(b))(P)]$
$= \lambda P.P(a) \sqcup P(b)$
$= \lambda P.P(a) \vee P(b)$

Extending the Focus Condition to other alternative-activating features, I propose a more general condition as follows:

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

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$_F$.

a. $\rightsquigarrow$ *Mary invited John.* — Prejacent presupposition

b. $\rightsquigarrow$ *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))
$[\![only_C]\!] = \lambda p \lambda w : p(w) = 1. \forall q \in \textsc{Excl}(p, C)[p \not\subseteq q \rightarrow q(w) = 0]$

(30) **Excludable (excl-)alternatives** (Standard)
$\textsc{Excl}(p, C) = \{q \mid p \not\subseteq q \wedge q \in C\}$

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$_F$, (not Mary / not both).

b. # Only BOTH$_F$.

c. BOTH$_F$.

The *which*-question restricts the quantification domain of *only* to the following set: $C = \{\phi_j, \phi_m, \phi_{j \oplus m}\}$ where ϕ_x = *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.[11]

(32) **The meaning of *only*** (Final)

$$[\![only_C]\!] = \lambda p \lambda w : \underbrace{\exists q \in \textsc{Excl}(p,C)}_{\text{non-vacuity}} \wedge \underbrace{p(w)=1}_{\text{prejacent}} . \underbrace{\forall q \in \textsc{Excl}(p,C)[q(w)=0]}_{\text{exhaustivity}}$$

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.

(33) **The meaning of *dou***

$$[\![dou_C]\!] = \lambda p \lambda w : \underbrace{\exists q \in \textsc{Sub}(p,C)}_{\text{non-vacuity}} . \underbrace{p(w)=1}_{\text{prejacent}} \wedge \underbrace{\forall q \in \textsc{Sub}(p,C)[O_C(q)(w)=0]}_{\text{anti-exhaustivity}}$$

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).

(34) **Sub-alternatives**

$\textsc{Sub}(p,C) = (C - \textsc{Excl}(p,C)) - \{p\}$

(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).

(35) **Sub-alternatives as weaker alternatives** (By standard excludability)

$\textsc{Sub}(p,C) = \{q \mid p \subset q, q \in C\}$

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

[11] 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.

(i) **A cross-categorical semantics of *only***

$$[\![only_C]\!] = \lambda f_\alpha \lambda P_{\langle \alpha, st \rangle} \lambda w_s : \underbrace{P(f)(w)=1}_{\text{prejacent pres.}} \wedge \underbrace{\exists f' \in C[P(f) \not\subseteq P(f')]}_{\text{non-vacuity pres.}} . \underbrace{\forall f' \in C[P(f) \not\subseteq P(f') \rightarrow P(f)(w)=0]}_{\text{exhaustivity assertion}}$$

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]

(36) **The *O*-operator** (Chierchia et al. 2012)
$O_C = \lambda p \lambda w : p(w) = 1 \wedge \forall q \in \textsc{Excl}(p, C)[q(w) = 0]$
(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]

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[12]When *dou* is used as a scalar operator, pre-exhaustification is realized by applying a scalar exhaustifier ($\approx$ *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.

[13]Note 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**

a. $O_C = \lambda q \lambda w : q(w) = 1 \wedge \forall r \in \textsc{Excl}(q, C)[r(w) = 0]$
$\quad = \lambda q \lambda w : q(w) = 1 \wedge \forall r \in ((C - \textsc{Sub}(q, C)) - \{q\})[r(w) = 0]$ By (34)

b. $[\![dou_C]\!] = \lambda p \lambda w : \exists q \in \textsc{Sub}(p, C).p(w) = 1 \wedge \forall q \in \textsc{Sub}(p, C)[O_C(q)(w) = 0]$
$\quad = \lambda p \lambda w : \exists q \in \textsc{Sub}(p, C).p(w) = 1 \wedge$
$\quad\quad \forall q \in \textsc{Sub}(p, C)[q(w) = 0 \vee \neg \forall r \in ((C - \textsc{Sub}(q, C)) - \{q\})[r(w) = 0]]$ By (i-a)

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

[14]One 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: $\textbf{dou}_C$ [$_S$ [John and Mary]$_{[+F]}$ arrived]

b. $[\![S]\!] = \textit{arrive}(j \oplus m)$

c. $C = \{\textit{arrive}(x) \mid x_e \text{ is a relevant individual}\}$

d. $\textsc{Sub}([\![S]\!], C) = \{\textit{arrive}(j), \textit{arrive}(m)\}$

e. $[\![dou_C(\text{S})]\!] = \textit{arrive}(j \oplus m) \wedge \neg O[\textit{arrive}(j)] \wedge \neg O[\textit{arrive}(m)] = \textit{arrive}(j \oplus m)$

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

with 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 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] (#**dou**) 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.]

[15] The 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.[16] To disambiguate, this section uses C for the cover variable and $C_{\text{F-ALT}}$ 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 $a \oplus b \oplus c$. Alternatives of the prejacent clause are derived by replacing $a \oplus b \oplus c$ 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).[17]

(39) $\textbf{Dou}_{C_{\text{F-ALT}}}$ [$_S$ $a \oplus b \oplus c$ bought houses]

a. $[\![S]\!] = \text{PART}_C(f, a \oplus b \oplus c)$

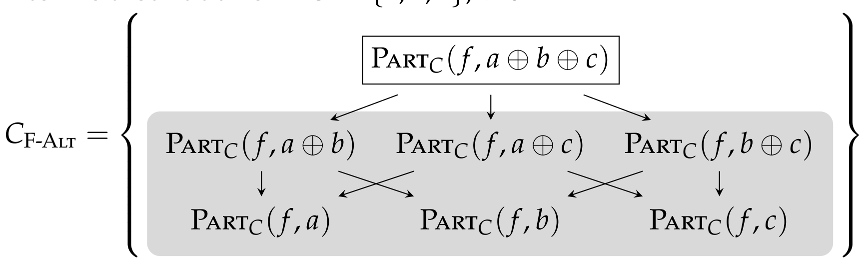
b. $C_{\text{F-ALT}} = \{\text{PART}_C(f, x) \mid x_e \text{ is relevant}\}$

c. $\text{SUB}([\![S]\!], C_{\text{F-ALT}}) = \{\text{PART}_C(f, x) \mid x_e \text{ is relevant and } \exists C' \subset C[x = \bigoplus C']\}$

The quantification domain of *dou* is illustrated in the following. For simplicity, I ignore alternatives based on individuals that are not parts of $a \oplus b \oplus c$. 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*:

√ **Atomic distributive:** If $C = \{a, b, c\}$, then ...



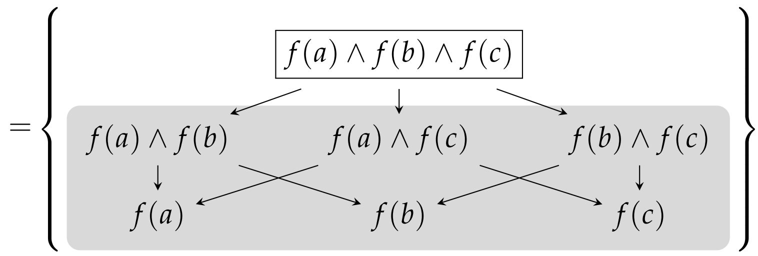
[16] In the alternatives, the value of C always equals the contextually determined cover of the associated item in the prejacent (viz., the cover of $a \oplus b \oplus c$), and PART only distributes over C. (See Liao 2011: chap. 4.) For example, if $C = \{a, b, c\}$, the alternative $\text{PART}_C(f, d)$ is vacuously a tautology (namely, it is true iff f holds for every subpart of d that is in $\{a, b, c\}$), and the alternative $\text{PART}_C(f, a \oplus b \oplus c \oplus d)$ is logically equivalent to $\text{PART}_C(f, a \oplus b \oplus c)$. 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_F bought houses. $\rightsquigarrow$ *d didn't buy houses.*

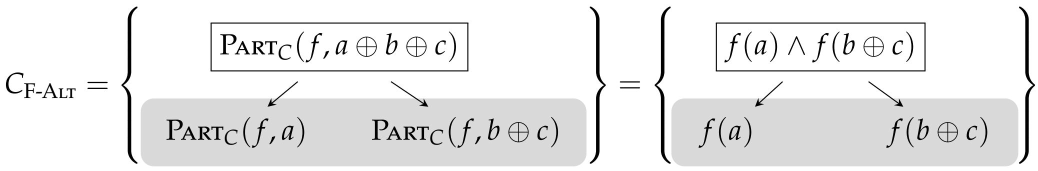
See a solution in Liu (2016c) based on Link-Landman's approach to encoding distributivity/collectivity distinction. Details regarding to Liu's formal implementations are omitted due to the scope of this paper.

[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) $\text{SUB}([\![S]\!], C_{\text{F-ALT}}) = \{\text{PART}_C(f, x) \mid x_e \text{ is contextually relevant and } \varnothing \subset \{y \mid y \leq x \wedge C(y)\} \subset C\}$
(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.)



$\surd$ **Non-atomic distributive:** If $C = \{a, b \oplus c\}$, then ...



$\times$ **Collective:** If $C = \{a \oplus b \oplus c\}$, then ...
$C_{\text{F-ALT}} = \{f(a \oplus b \oplus c)\}$ and $\textsc{Sub}([\![S]\!], C_{\text{F-ALT}}) = \varnothing$

In conclusion, the particle *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 *dou* can be associated with the distributive expression NP-*gezi* 'NP-each'. In sentences like (40), the presence of the distributor *gezi* 'each' is not redundant; instead, it is required for satisfying the non-vacuity presupposition of *dou*. If *gezi* is not overtly used and the predicate following *dou* is non-distributive in lexicon, there would still be a covert distributor in the sentence.

(40) [Tamen gezi] **dou** you yixie youdian.
They each DOU have some advantage
'They each **dou** has some advantages .'

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

(41) A predicate P is **divisive** iff $\forall x[P(x) \rightarrow \forall y \leq x[y \in \textsc{Dom}(P) \rightarrow P(y)]]$
(Whenever P holds of something x, it also holds of every subpart of x defined for P.)

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

(42) a. [Tamen] (**dou**) shi pengyou.
they DOU be friends
'They are (all) friends.'

b. [Tamen] (**dou**) zai dating jihe -le.
they DOU at hallway gather -ASP
'They (all) gathered in the hallway.'

c. [Tamen] (**dou**) jian-guo-mian -le.
they DOU see-EXP-face -ASP
'They (all) have met.'

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 λx.*John 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 λx.*John 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.'

b. Yuehan ba [na-ge pingguo] (*__dou__) chi -le yi-ban.
John BA that-CL apple DOU eat -PERF one-half
Intended: 'John ate half of that apple.'

(44) a. *John ate that apple* $\Rightarrow$ *John ate* x ($x <$ *that apple*)
SUB (*John ate that apple*) = {*John ate* x | $x <$ *that apple*}

b. *John ate half of that apple* $\not\Rightarrow$ *John ate half of* x ($x <$ *that apple*)
SUB (*John ate half of that apple*) $= \varnothing$

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: $\textbf{dou}_C$ [$_S$ [John $\text{or}_{[+D]}$ Mary] can teach Intro Chinese] (To be revised in (64))

b. $[\![S]\!] = \Diamond\phi_j \vee \Diamond\phi_m$ $\quad\quad \phi_x = x$ *teach Intro Chinese*

c. $C = \text{D-ALT}(S) = \{\Diamond\phi_j, \Diamond\phi_m, \Diamond\phi_j \vee \Diamond\phi_m\}$

d. $\text{SUB}([\![S]\!], C) = \{\Diamond\phi_j, \Diamond\phi_m\}$

e. $$\begin{aligned}[\![\textbf{dou}_C\ (S)]\!] &= [\Diamond\phi_j \vee \Diamond\phi_m] \wedge \neg O_C\Diamond\phi_j \wedge \neg O_C\Diamond\phi_m \\ &= [\Diamond\phi_j \vee \Diamond\phi_m] \wedge [\Diamond\phi_j \rightarrow \Diamond\phi_m] \wedge [\Diamond\phi_m \rightarrow \Diamond\phi_j] \\ &= [\Diamond\phi_j \vee \Diamond\phi_m] \wedge [\Diamond\phi_j \leftrightarrow \Diamond\phi_m] \\ &= \Diamond\phi_j \wedge \Diamond\phi_m\end{aligned}$$

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 what 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 ϕ_x abbreviate for the proposition x *teaches Intro Chinese*, we have $\{\Diamond\phi_j, \Diamond\phi_m\}^\neg \cup \{\Diamond\phi_j \vee \Diamond\phi_m\}$ is inconsistent, because $[\Diamond\phi_j \vee \Diamond\phi_m] \wedge \neg\Diamond\phi_j \wedge \neg\Diamond\phi_m = \bot$.) 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)
$\text{IEXCL}(p, C) = \bigcap\{A \mid A$ is a maximal subset of C such that $\{\neg q \mid q \in A\} \cup \{p\}$ is consistent$\}$

[18] Another 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) $\text{IEXCL}(p, C) = \{q \mid q \in C \wedge \underline{\neg\exists q' \in \text{EXCL}(p, C)[[p \wedge \neg q] \rightarrow q']}\}$
(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)
$\textsc{Sub}(p, C) = (C - \text{IE}\textsc{xcl}(p, C)) - \{p\}$
(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)
$[\![dou_C]\!] = \lambda p \lambda w : \exists q \in \textsc{Sub}(p, C).p(w) = 1 \wedge \forall q \in \textsc{Sub}(p, C)[O_C(q)(w) = 0]$
where $\textsc{Sub}(p, C)$ is defined as in a or b:

a. Def strong (Based on regular excludability)
$\textsc{Sub}(p, C) = (C - \text{E}\textsc{xcl}(p, C)) - \{p\}$

b. Def weak (Based on innocent excludability)
$\textsc{Sub}(p, C) = (C - \text{IE}\textsc{xcl}(p, C)) - \{p\}$

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 ∀-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 ∀-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* 'what'-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 ∀-FCI while post-verbal *shenme*-NP an ∃-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.
b. John must read a book, 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.
⇝ *You can invite Andy and you can invite Billy.*

b. You must invite Andy or Billy.
⇝ *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 ∀-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 ∀-FCI use of a pre-verbal *wh*-expression or a polarity item (e.g., *renhe* 'any'-NP), *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 *shei* 'who' can be licensed as a ∀-FCI in an episodic *dou*-sentence like (55a). This distributional pattern, however, is very unproductive: the other episodic *dou*-sentence (55b) sounds very odd. Hence, there must be some salvaging effect from the experiential maker *-guo* on FCI-licensing. I leave this puzzle open.

(55) a. [Shei] **dou** jiao -guo jichu hanyu.
who DOU teach -EXP intro Chinese.
'Everyone has taught Intro Chinese.'

b. ?? [Shei] **dou** jinlai -le.
who DOU enter -ASP.
Intended: 'Everyone came in.'

The licensing conditions of pre-verbal *na*-CL-NP 'which-NP' and *renhe*-NP 'any-NP' are even harder to generalize. Giannakidou and Cheng (2006) claim that the ∀-FCI use of these items are only licensed in a pre-*dou*+$\Diamond$ 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] **dou** keyi/??bixu jinlai.
which-CL/any -person DOU can/must enter
Intended: 'Everyone can/must come in.'

b. ?? [Na-ge/Renhe -ren] **dou** shou dao -le yaoqing.
which-CL/any -person DOU get arrive -ASP invitation
Intended: 'Everyone got an invitation.'

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

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

5.2.3. The role of *dou* in licensing FCIs

This section explains why in Mandarin the presence of *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 *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*: $\textbf{dou}_C$ [$\text{shei}_{[+\text{D}]}$ can teach Intro Chinese]

b. The LF in the absence of *dou*: O_C [$\text{shei}_{[+\text{D}]}$ 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. $[\![\text{S}]\!] = \Diamond\phi_a \vee \Diamond\phi_b$ S = 'shei$_{[+\text{D}]}$ can teach Intro Chinese'

b. $C = \text{D-A}\textsc{lt}(\text{S}) = \{\Diamond\phi_a, \Diamond\phi_b, \Diamond\phi_a \vee \Diamond\phi_b\}$

c. $\text{E}\textsc{xcl}([\![\text{S}]\!], C) = \text{S}\textsc{ub}([\![\text{S}]\!], C) = \{\Diamond\phi_a, \Diamond\phi_b\}$

d. $[\![O_C(\text{S})]\!] = [\Diamond\phi_a \vee \Diamond\phi_b] \wedge \neg\Diamond\phi_a \wedge \neg\Diamond\phi_b = \bot$

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_{DOU}-operator proposed by Xiang (2016c) and Xiang (2016a: chap. 2) for interpreting mention-some questions? I argue that the covert O_{DOU}-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':[20]

(59) a. Ni [renhe-ren] *(**dou**) keyi jian.
You any-person DOU can meet.
'Anyone is such that you can meet with.'

b. $^{\text{OK}}$*dou*/*O_{DOU} [anyone$_i$ you can meet with t_i]

(60) a. Ni (***dou**) keyi jian [renhe-ren].
You DOU can meet any-person
'You can meet with anyone.'

b. **dou*/$^{\text{OK}}O_{\text{DOU}}$ [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_{DOU}-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

[20]No matter whether the FCI takes scope above or below the possibility modal, applying **dou**/O_{DOU} yields the same truth conditions, as shown in the following computation:

(i) a. $\textbf{dou}(\Diamond p \vee \Diamond q) = (\Diamond p \vee \Diamond q) \wedge \neg O\Diamond p \wedge \neg O\Diamond q = \Diamond p \wedge \Diamond q$ For pre-verbal FCI

b. $O_{\text{DOU}}(\Diamond(p \vee q)) = \Diamond(p \vee q) \wedge \neg O\Diamond p \wedge \neg O\Diamond q = \Diamond p \wedge \Diamond q$ For post-verbal FCI 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 ∀-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 ∀-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 ∃-indefinites and derives ∀-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 ∀-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 $M_{\text{SI}} \subset M_{\text{FC}}$.[21] This analysis also does not extend to ∀-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.[22] 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 $M_{\text{FC}} = \{w_1, w_2, w_3\}$ and $M_{\text{SI}} = \{w_1, w_2\}$, the two inferences in (i) are not contradictory — both inferences are true if ϕ_a is true only in w_1 and ϕ_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 $M_{\text{SI}} \subset M_{\text{FC}}$
FC: $\Diamond_{M_{\text{FC}}} \phi_a \wedge \Diamond_{M_{\text{FC}}} \phi_b$
SI: $\neg[\Diamond_{M_{\text{SI}}} \phi_a \wedge \Diamond_{M_{\text{SI}}} \phi_b]$

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

[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.

(62) a. Ruguo Yuehan huozhe Mali jiao-le jichu hanyu, wo jiu bu-danxin.
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 huozhe Mali] **dou** jiao-le jichu hanyu, wo jiu bu-danxin.
If John or Mary DOU 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 Obviation, Dayal (2013) proposes a *Viability Constraint*: every exhaustified 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 $\Diamond$-sentence (63a) are consistent. For example, both formulas are true if $M = \{w_1, w_2, w_3\}$ and $f = \{\langle w_1, \{a\}\rangle, \langle w_2, \{b\}\rangle, \langle w_3, \{a, b\}\rangle\}$. (The pair $\langle w_1, \{a\}\rangle$ is read as 'only a comes in w_1.') In contrast, the two formulas for the $\Box$-sentence (63b) are contradictory: for any modal M such that $\Box_M f(a)$ is true, $\Box_M[f(b) \wedge \neg f(a)]$ is false.

(63) a. Anyone can come.
FC: $\Diamond_M f(a) \wedge \Diamond_M f(b)$ (f stands for the property *came*)
Viability: $\Diamond_M[f(a) \wedge \neg f(b)] \wedge \Diamond_M[f(b) \wedge \neg f(a)]$

b. *Anyone must come.
FC: $\Box_M f(a) \wedge \Box_M f(b)$
Viability: $\Box_M[f(a) \wedge \neg f(b)] \wedge \Box_M[f(b) \wedge \neg f(a)]$

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 $\Diamond$-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]

[23] This 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 Obviation effect in the licensing of $\forall$-FCIs.

[24] Chierchia (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 $\Diamond O\phi_a \wedge \Diamond O\phi_b \wedge \Diamond O\phi_c$ (ϕ_x 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 $\forall$-FCIs.

(i) [Andi Bili huo Xindi] 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 at-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 [x_F sits next to a student]' is a contradiction. I leave this issue open.

(64) $\textbf{dou}_C$ [$_S$ [John or$_{[+D]}$ Mary] λx can [$O_{C'}$ [$_{VP}$ $x_{[+F]}$ teach Intro Chinese]]]

a. $C' = \text{F-Alt}(\text{VP}) = \{\phi_x \mid x \in D_e\}$ (ϕ_x stands for x *teach Intro Chinese*)

b. $[\![\text{S}]\!] = \Diamond O_{C'}\phi_m \vee \Diamond O_{C'}\phi_j$

c. $C = \text{D-Alt}(\text{S}) = \{\Diamond O_{C'}\phi_m \vee \Diamond O_{C'}\phi_j, \Diamond O_{C'}\phi_m, \Diamond O_{C'}\phi_j\}$

d. $\textbf{dou}_C([\![\text{S}]\!]) = [\Diamond O_{C'}\phi_m \vee \Diamond O_{C'}\phi_j] \wedge \neg O_C \Diamond O_{C'}\phi_m \wedge \neg O_C \Diamond O_{C'}\phi_j$
$= \Diamond O_{C'}\phi_m \wedge \Diamond O_{C'}\phi_j$
(John and Mary each can teach Intro Chinese alone.)

In the absence of a possibility modal, locally exhaustified conjunctive inferences are contradictory. Therefore, the corresponding episodic sentence and $\Box$-sentence are ungrammatical.

(65) a. * $\textbf{dou}_C$ [$_S$ [John or$_{[+D]}$ Mary] λx [$O_{C'}$ [$_{VP}$ $x_{[+F]}$ teach Intro Chinese]]]
$\textbf{dou}_C([\![\text{S}]\!]) = O_{C'}\phi_j \wedge O_{C'}\phi_m = \bot$

b. * $\textbf{dou}_C$ [$_S$ [John or$_{[+D]}$ Mary] λx must [$O_{C'}$ [$_{VP}$ $x_{[+F]}$ teach Intro Chinese]]]
$\textbf{dou}_C([\![\text{S}]\!]) = \Box O_{C'}\phi_j \wedge \Box O_{C'}\phi_m = \bot$

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.
$\rightsquigarrow$ *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$_F$.
$\rightsquigarrow$ *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: $[\![\textit{even}_C(\text{S})]\!]$ is defined only if $C \subseteq \text{F-Alt}(\text{S})$. 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)

$[\![even_C]\!] = \lambda p \lambda w : \forall q \in C[p \neq q \rightarrow q >_{\text{likely}} p].p(w) = 1$
(For any proposition p: $[\![even]\!](p)$ is defined only if p is less likely than *all* of its contextually relevant F-alternatives that are not identical to it; when defined, $[\![even]\!](p) = p$.)

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.

(68) **Semantics of** *even* (Bennett 1982; Kay 1990)
$[\![even_C]\!] = \lambda p \lambda w : \exists q \in C[q >_{\text{likely}} p].p(w) = 1$
(For any proposition p: $[\![even]\!](p)$ is defined only if p is less likely than *at least one* of its contextually relevant F-alternatives; when defined, $[\![even]\!](p) = p$.)

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 "S_1 and *even*-S_2" implicates that either (i) *even*-S_1 is infelicitous (i.e., that the evaluative scalar presupposition, that S_1 is unlikely, is false,) or at least that (ii) *even*-S_2 does not grant the felicity of *even*-S_1 (i.e., that S_2 is unlikely does not entail that S_1 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 FInals$_F$, and Bill also **even** made it to the SEMI-finals$_F$!

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

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

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

Greenberg (2019a) argues that this condition is too strong. In the following example, the utterances by B_1 and B_2 are

(72) **The felicity condition of coordinating clauses with evaluatives**
For an evaluative expression δ, 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.
$\not\rightsquigarrow$ *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.
$\rightsquigarrow$ *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.

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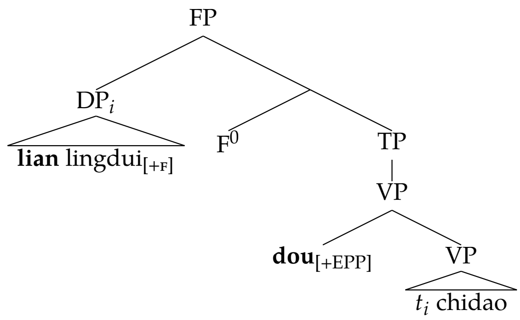
both felicitous, despite that the evaluative inference of *Bill only wrote 5*, namely that writing 5 papers is not well, is true.

(ii) A: How many papers did your faculty members write in this period?
B_1: Well, John did great. He wrote 8 papers. The rest didn't do so well: Bill wrote 5, and Susan **only** wrote 4.
B_2: 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).

(75) **Lian** [LINGDUI$_F$] **dou** chidao -le.
LIAN team-leader DOU late -PERF
'Even the team leader was late.'



When *dou* is associated with *lian*-FocP, the measurement used for ordering alternatives gets shifted from logical strength to likelihood.[26] 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,[27] 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).[28] In analogy to the *O*-exhaustifier, JUST affirms the prejacent and states a scalar exhaustivity condition that no true alternative is more likely.

(76) **Sub-alternatives as more likely alternatives** (By likelihood)
$\textsc{Sub}(p, C) = \{q \mid q \in C \wedge q >_{\text{likely}} p\}$

(77) $\textsc{just}_C(q) = \lambda w : q(w) = 1 \wedge \forall r \in C[r(w) = 1 \rightarrow q \leq_{\text{likely}} r]$
(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.

(78) **Semantics of** *dou* (in the [*lian* 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 *even*-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 $p_1 \cap p_2 = \varnothing$, then $\Pr(p_1 \cup p_2) = \Pr(p_1) + \Pr(p_2)$. Accordingly, we have:

(i) If $p \subset q$, 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**$_C$(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) $O_C(q) = \lambda w : q(w) = 1 \wedge \forall r \in ((C - \textsc{Sub}(q, C)) - \{q\})[r(w) = 0]$
$= \lambda w : q(w) = 1 \wedge \forall r \in ((C - \{r' \mid r' \in C, r' >_{\text{likely}} q\}) - \{q\})[r(w) = 0]$
$= \lambda w : q(w) = 1 \wedge \forall r \in C[r <_{\text{likely}} q \rightarrow r(w) = 0]$
$= \lambda w : q(w) = 1 \wedge \forall r \in C[r(w) = 1 \rightarrow q \leq_{\text{likely}} r]$
$= \textsc{just}_C(q)$

$[\![dou_C]\!] = \lambda p \lambda w : \exists q \in \textsc{Sub}(p, C).p(w) = 1 \wedge \forall q \in \textsc{Sub}(p, C)[\textsc{just}_C(q)(w) = 0]$
where $\textsc{Sub}(p, C) = \{q \mid q \in C \wedge q >_{\text{likely}} p\}$

(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 *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 *dou* simply affirms its propositional argument, or equivalently, is vacuous. Finally, we get a *dou* semantically equivalent to *even*: the non-vacuity presupposition of *dou* is equivalent to the existential scalar presupposition of *even*, and the operator *dou* does not affect the assertion.

(79) $[\![dou_C]\!]$
$= \lambda p \lambda w : \exists q \in \textsc{Sub}(p, C).p(w) = 1 \wedge \forall q \in \textsc{Sub}(p, C)[\textsc{just}_C(q)(w) = 0]$
$= \lambda p \lambda w : \exists q \in \textsc{Sub}(p, C).p(w) = 1 \wedge \forall q \in \textsc{Sub}(p, C)\exists r \in C[r(w) = 1 \wedge q >_{\text{likely}} r]$
$= \lambda p \lambda w : \exists q \in C[q >_{\text{likely}} p].p(w) = 1 \wedge \underline{\forall q \in C[q >_{\text{likely}} p \rightarrow \exists r \in C[r(w) = 1 \wedge q >_{\text{likely}} r]]}$
$= \lambda p \lambda w : \exists q \in C[q >_{\text{likely}} p].p(w) = 1$
(For any proposition p: $[\![dou_C]\!](p)$ is defined only if p is less likely than at least one of its contextually relevant alternatives; when defined, $[\![dou_C]\!](p) = p$.)
$= [\![even_C]\!]$

Thus, it is plausible to say that the *even*-like interpretation of the [*lian* Foc *dou* ...] construction comes from the non-vacuity presupposition of *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 α has at least one F-alternative distinct from itself.

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

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-*dou* negation must be present, as exemplified in (81). However, there are also cases where the post-*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.' (≈ 'John does not want any money.')
Without negation: 'John wants it even if it is just one cent.' (≈ '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 iff she is a linguist.
$\not\Uparrow$ $\not\Downarrow$
I'll invite Li iff 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 did**n'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 Scalarity** (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: $C = \{\textit{John made } n \textit{ videos} \mid n \in \mathbb{N}^+\}$. 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 $\text{one}_{[+F]}$ 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.[29] In both cases, with a proper context, the prejacent of *even* can be less likely than (at least) some of the alternatives in *C*.

(87) John did**n't** make even ONE video.
   a. Even_C [$_{\text{DE}}$ **not** [~~even_C~~ [John made $\text{one}_{[+F]}$ 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 [$_{\text{NM}}$ I **hope** to [~~even_C~~ [someday make $\text{one}_{[+F]}$ 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 ...] $\not\supseteq$ 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$_F$-ge ren] **dou** *(bu) renshi.
John LIAN one-CL person DOU NEG know
'John does not even know ONE person.'

a. * Dou$_C$ [$_{UE}$ [lian (one$_{[+F]}$ person)]$_i$ **not** [John knows t_i]] MIN ≫ NEG
for any $n > 1$: $\exists 1x \neg[\mathit{know}(j, x)] \supset \exists nx \neg[\mathit{know}(j, x)]$

b. Dou$_C$ [$_{DE}$ **not** [John knows [lian (one$_{[+F]}$ person)]]] NEG ≫ MIN
for any $n > 1$: $\neg\exists 1x[\mathit{know}(j, x)] \subset \neg\exists nx[\mathit{know}(j, x)]$

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$_F$-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$_F$-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. Dou$_C$ [$_{NM}$ John$_i$ **wants to** [[lian (one$_{[+F]}$ cent)] λx [e_i 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-

[30] Mandarin 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
(^{OK}EVERY ≫ NEG, $^{\#}$NEG ≫ EVERY)

b. You yi-ge-ren mei lai.
exist one-CL-person NEG come
(^{OK}SOME ≫ NEG, $^{\#}$NEG ≫ SOME)

alternatives as the ones that rank lower than the prejacent proposition with respect to this measurement.[31]

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

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) **Dou** [WU$_F$-dian] -le.
DOU five-o'clock -ASP
'It is already FIVE o'clock.' ⇝ *It's too late.*
a. $C = \{\textit{it's } n \textit{ o'clock} \mid n \in \mathbb{N}, 0 \leq n \leq 24\}$
b. $\textsc{Sub}(\textit{it's five o'clock}, C) = \{\textit{it's 4 o'clock}, \textit{it's 3 o'clock}, ...\}$

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

(94) Ta **dou** yijing lai -guo zher [LIANG/*YI$_F$-ci] -le.
he DOU already come -EXP here two/one-time -ASP.
'He has already been here twice/*once.'

6. Sorting the parameters

In sum, I have defined *dou* uniformly as pre-exhaustification exhaustifier that negates pre-exhaustified sub-alternatives, as repeated from (33). This semantics derives the three uses of *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.

(95) $$[\![dou_C]\!] = \lambda p \lambda w : \underbrace{\exists q \in \textsc{Sub}(p, C)}_{\text{non-vacuity}} . \underbrace{p(w) = 1}_{\text{prejacent}} \wedge \underbrace{\forall q \in \textsc{Sub}(p, C)[O_C(q)(w) = 0]}_{\text{anti-exhaustivity}}$$

I have also shown that the alternations in function of *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.

[31] See Greenberg (2018, 2019b) for a refined analysis of English *even* that makes use of general gradability instead of likelihood. Her analysis also extends to the Mandarin particle *dou*.

	Definition of sub-alternatives	Function of *dou*
Def (a)	Alternatives that are **weaker** than the prejacent	Distributor
Def (b)	Alternatives that are **not I-excludable**	∀-FCI-licenser
Def (c)	Alternatives that are **more likely** than the prejacent	Even
Def (d)	Alternatives ranked lower than the prejacent w.r.t. a relevant measurement	Scalar marker

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.

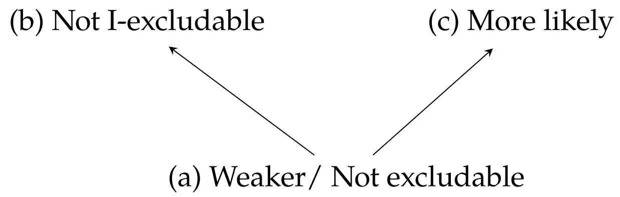


Figure 1: Development path for sub-alternatives

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.).

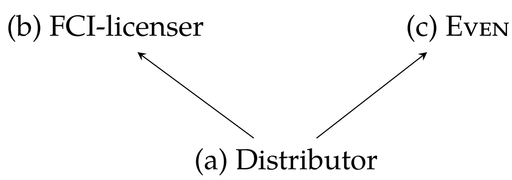


Figure 2: Development path for the uses of *dou*

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.[32] This prediction is supported by the synchronic distribution of *dou* in basic declaratives and in [(*lian*) ... *dou* ...] 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 [*lian* ... *dou* ...] 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.

If the prejacent of *dou* is ...	Can the non-vacuity presupposition of *dou* be satisfied in ...	
	... basic declaratives?	... [(*lian*) ... *dou* ...] constructions?
A. stronger than some alternative(s)	Yes	Yes
B. the weakest alternative	No	No
C. neither	**No**	Yes

Table 2: Distribution of *dou* in declaratives and [(*lian*) ... *dou* ...] 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 [(zhe) san-wan fan] **DOU** chi-de-wan.
John DEM three-bowl rice DOU eat-mod-finish
'John can eat up (these) three bowls of rice.'

b. Yuehan (lian) [SAN$_F$-wan fan] **dou** chi-de-wan.
John LIAN three-bowl rice DOU eat-mod-finish
'John can even eat up 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 [(*lian*)...*dou*...] 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.

[32] For 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.

[33] There 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 [(*lian*) ... *dou* ...] sentence (96b).

(97) a. Yuehan [(zhe) *yi/san-ge ren] **dou** renshi.
John this one/three-CL person DOU know
'John knows all the *one/three people.'

b. Yuehan (lian) [YI$_F$-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$_F$ arrived* cannot be logically weaker than any of its alternatives (i.e., propositions of the form x_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$_F$ 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.

(98) a. * [Yuehan] **DOU** dao-le.
John DOU arrive-PERF
'John (*all) arrived.'

b. (Lian) [YUEHAN$_F$] **dou** dao-le.
LIAN John DOU arrive-PERF
'Even JOHN$_F$ 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$_F$] **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 ∀-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 ∀-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 σ-alternative (i.e., $\Diamond[p \wedge q]$) and F-alternatives (e.g., $\Diamond r$). The D-alternatives are not negated in this round, because they are not I-excludable. The outer exhaustification affirms the exhaustified prejacent and negates the pre-exhaustified D-alternatives.

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

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]

(101) $$\begin{aligned} O^R_C(p) = \lambda w : p(w) = 1 \wedge \forall q \in \textsc{Sub}(p, C)[O_C(q)(w) = 0] \\ \wedge \forall q' \in \text{IE}\textsc{xcl}(p, C)[q'(w) = 0] \\ \text{where } \textsc{Sub}(p, C) = (C - \text{IE}\textsc{xcl}(p, C)) - \{p\} \end{aligned}$$

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) [John or Mary] **dou** can teach Intro Chinese.
a. LF: $\textbf{dou}_{C'}$ [O^R_C [$_S$ [John or$_{[+D]}$ Mary] can teach Intro Chinese]]
b. $[\![dou_{C'}]\!] = \lambda p \lambda w : \exists q \in C[p \subset q].p(w) = 1$
c. $C = \text{D-A}\textsc{lt}(\text{S}) = \{\Diamond\phi_j \vee \Diamond\phi_m, \Diamond\phi_j, \Diamond\phi_m\}$

[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).

d. $C' = \{O^R_C(p) \mid p \in \text{D-ALT}(S)\} = \{O^R_C[\Diamond\phi_j \vee \Diamond\phi_m], O^R_C\Diamond\phi_j, O^R_C\Diamond\phi_m\}$

This analysis is quite appealing, but it faces two problems. First, it requires the D-alternatives of the prejacent disjunction to be used twice: once is by the recursive 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.[35] 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.[36]

(103) The alternatives in (102d) are mutually exclusive:

a. $O^R_C[\Diamond\phi_j \vee \Diamond\phi_m] = \Diamond\phi_j \wedge \Diamond\phi_m$

b. $O^R_C\Diamond\phi_j = O\Diamond\phi_j = \Diamond\phi_j \wedge \neg\Diamond\phi_m$

c. $O^R_C\Diamond\phi_m = O\Diamond\phi_m = \Diamond\phi_m \wedge \neg\Diamond\phi_j$

One might suggest to solve this problem by stipulating that recursively exhaustifying one disjunct does not negate the other disjunct (for example, let $O^R_C\Diamond\phi_j = \Diamond\phi_j$). Then, the domain of *dou* would be pleasantly as follows: $C' = \{\Diamond\phi_j \wedge \Diamond\phi_m, \Diamond\phi_j, \Diamond\phi_m\}$. However, in Fox's (2007) derivation of ∃-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. $O'O\Diamond[p \vee q]$
$= O\Diamond[p \vee q] \wedge \neg O\Diamond p \wedge \neg O\Diamond q$
$= \Diamond[p \vee q] \wedge \neg\Diamond[p \wedge q] \wedge \neg\Diamond p \wedge \neg\Diamond q$
$= \bot$

b. $O'O\Diamond[p \vee q]$
$= O\Diamond[p \vee q] \wedge \neg O\Diamond p \wedge \neg O\Diamond q$
$= \Diamond[p \vee q] \wedge \neg\Diamond[p \wedge q] \wedge \neg[\Diamond r \vee \Diamond s] \wedge [\Diamond p \to \Diamond r \vee \Diamond s] \wedge [\Diamond q \to \Diamond r \vee \Diamond s]$
$= \Diamond[p \vee q] \wedge \neg\Diamond[p \wedge q] \wedge \neg[\Diamond r \vee \Diamond s] \wedge \neg\Diamond p \wedge \neg\Diamond q$
$= \bot$

[35] In computing the embedded recursive exhaustification, F-alternatives must be pruned to avoid the undesired exclusive inference. Complications with σ-alternatives are ignored here.

[36] Crnič (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) Op$_{C'}$ [D 3 O^R_C [... any t_3 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) (**Lian**) JOHN$_F$ **dou** arrived.

a. [E$_C$ [JOHN$_{[+F],i}$ **dou** t_i arrived]]

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

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) **Semantics of** *dou* (Liu 2016b,c, 2018)

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

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) If **lian** JOHN$_F$ **dou** came, Mary would be happy.

a. $\rightsquigarrow$ *Compared with others, JOHN is less likely to come.*

b. $\not\rightsquigarrow$ *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, $^{\text{OK}}$distributive)

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. $\textbf{dou}_{C'}$ [O^R_C [John or Mary can teach Intro Chinese]]

b. $[\![dou_{C'}]\!] = \lambda p \lambda w : \forall q \in C'[p \neq q \rightarrow p <_{\text{likely}} q].p(w) = 1$

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^R 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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