Linguist and Philos (2017) 40:61–95
DOI 10.1007/s10988-016-9199-y

ORIGINAL RESEARCH

Varieties of alternatives: Mandarin focus particles

Mingming Liu[1]

Published online: 24 December 2016

Abstract Mandarin focus particles systematically have heterogeneous uses. By examining details of two focus particles *jiu* 'only' and *dou* 'even', this paper explores the hypothesis that varieties of alternatives give rise to systematic 'ambiguities'. Specifically, by positing sum-based alternative sets and atom-based ones, it maintains unambiguous semantics of *jiu* as ONLY_{weak} and *dou* as EVEN, while deriving their variability through interaction with alternatives. Independently motivated analyses of distributive/collective readings and contrastive topics, combined with varieties of alternatives, deliver the full range of facts concerning *jiu* and *dou*. Theoretically, the paper illustrates an integration of Link-Landman's theory of pluralites into Rooth's alternative semantics.

Keywords Focus particles · ONLY · EVEN · Alternatives · Pluralities · Quantification

1 Introduction

Focus particles (FPs) (such as *jiu*, *dou*, *ye*,…) in Mandarin are adverbs syntactically; semantically, they systematically have heterogeneous uses. Take *jiu* and *dou* as examples: *jiu* can either have an exclusive semantics, similar to English *only* (1), or it can convey just a scalar reading but without the exclusive part (2); as for *dou*, it can either

✉ Mingming Liu
markliu@scarletmail.rutgers.edu

[1] School of Foreign Languages, Hunan University, Changsha, Hunan 410082, China

act like a distributive operator (3) (Lin 1998), or simply be a scalar particle similar to English *even* (4) (Shyu 1995; Chen 2008).[1,2]

(1) Jiu YUEHAN hui shuo fayu.
JIU John can speak French
'Only John can speak French.' *'only'*

(2) YUEHAN jiu hui shuo fayu.
John JIU can speak French
'John, who is easy to get hold of, can speak French.' *low-rank*

(3) TAMEN dou mai le yi liang chezi.
they DOU buy ASP one CL car
'They each bought a car.' *distributive operator*

(4) YUEHAN dou mai le yi liang chezi.
John DOU buy ASP one CL car
'Even John bought a car.' *'even'*

The feature of being ambiguous as illustrated above for *jiu* and *dou* applies to other FPs as well (see Hole 2004, Sect. 2 for a description of various uses for a variety of FPs), so it is unlikely to be an idiosyncrasy of a certain FP. Then, a natural question to ask is: why does Mandarin allow such massive ambiguities within the FP system? The current paper is devoted to answering this question with special reference to the two FPs *jiu* and *dou*.

Specifically, it will argue that for each FP, it is possible (and even necessary sometimes) to assign it a single unambiguous semantics, while deriving different 'uses' of the FP by varying choices of the alternative set associated with it.

Let me elaborate. First, I take it to be our basic assumption that an FP operates on a set of alternatives (Rooth 1985). Then, the meaning of an expression containing an FP is a function of (a) the meaning of the FP, (b) the meaning of FP's prejacent π,[3] and (c) π's alternatives.

With this background, what we propose about Mandarin FPs is that (c), instead of (a), is the locus of 'ambiguity': with varieties of alternatives, apparent distinct meanings can be derived without altering the semantics of the FP.

By making (c) the locus of generating 'ambiguities', we are not making any specific claim about any particular FP; rather, we are making a claim about the entire Mandarin

[1] The paper uses small capitals to indicate the associate of an FP, and underlying to highlight the relevant FP and to show its semantic contribution.

[2] *Jiu* and *dou* also have other temporal/modal uses, which are analyzable once the theory presented in this paper is properly enriched to include *events, times* and so on. But we must leave this for another occasion. Further, notice that syntactic positions of *jiu*'s associate (post-*jiu* (1) vs. pre-*jiu* (2)) correlates with different uses of *jiu*. An explanation of this fact is provided in Sect. 3.1, where we discuss the interaction of *jiu* and contrastive topics.

[3] Following Horn (1996), we call the FP-less part of the sentence containing a FP the FP's prejacent. For example, the prejacent of *only* in *Only John can speak French* is *John can speak French*. In the paper, π stands for either the prejacent sentence or its denotation (the prejacent proposition); as usual, contexts disambiguate.

FP system. Since Mandarin has the option of associating different sorts of alternatives with an FP, we predict that for each FP it is in principle possible to combine it with different sorts of alternative sets. This gives rise to 'ambiguities' for each FP; thus massive 'ambiguities'.

The idea of positing different sorts of alternative sets for a single alternative sensitive operator is not novel. A notable recent example is Chierchia (2013), who associates different sorts of alternatives (subdomain alternatives, scalar alternatives, pre-exhaustified subdomain alternatives, etc.) with two alternative sensitive operators (ONLY and EVEN), deriving different types of polarity sensitive items and thus unifying the polarity system. The current project can be seen as another implementation of Chierchia's general idea, extending it to the analysis of focus sensitive items.

Of course, the plausibility of the project depends on how successfully we can assign each of the FPs a unified semantics and at the same time account for its variability through varieties of alternatives. Thus, in this paper, we will use two case studies– *jiu* 'only' (Sect. 2.1) and *dou* 'even' (Sect. 2.2)—to demonstrate that our project is on the right track. Specifically, we will identify two types of alternative sets—sum-based ones and atom-based ones; together with a novel analysis of *jiu* as ONLY_{weak} and *dou* as EVEN, they account for the *jiu* and *dou* in (1)–(4). Next, in Sect. 3, we will explore how the proposal introduced in Sect. 2 interacts with other components of the grammar, and thus regulate the 'ambiguities' generated by varieties of alternatives. Finally, in Sect. 4 we will discuss issues that emerge when we consider the present proposal against earlier work on these topics, and in Sect. 5 we conclude.

2 Deriving 'ambiguities' through alternatives

2.1 *Jiu* as weak *only*

2.1.1 A weakened semantics of only

Let's start with (1). (1) has an exclusive inference contributed by *jiu*: people other than John cannot speak French. It is evidenced by (5), where continuing (1) with *(it's possible that) Lisi/someone else also can* is impossible. This is similar to English *only*, where any form of canceling/suspending of the exclusive inference is totally out (Horn 1996, a.o.), as shown in (6).

(5) #jiu YUEHAN hui shuo fayu, (keneng) Lisi ye hui.
JIU John can speak French, (possible) Lisi also can
'#Only John can speak French, (but It's possible) that Lisi also can.'

(6) #Only John speaks French, and/but Mary may too.

There is a vast literature on how to capture the exclusive inference of exclusive particles like *only* (see Coppock and Beaver 2014 for a recent discussion); (7) is an early attempt, due to Horn (1969), as cited in (Rooth 1996, p. 277).

(7) $[\![only_{Horn}(\pi)]\!]$ is true iff $\forall q \in C[\pi \neq q \rightarrow \neg q]$
Alternatives not equivalent to the prejacent are false.

Notice that the C in (7) is the quantificational domain of *only* and it is restricted by focus: focus on an expression a triggers alternatives which share with a the same semantic type (Rooth 1985). C is required to be a subset of the set of propositions obtained by replacing the focus part of the prejacent with its alternatives. This is formally represented in (8) (cf. the Focus Interpretation Principle in Rooth 1992, Sect. 3).

(8) $C \subseteq \{q \mid \exists x.(x \in \mathcal{A}lt([\![Focus]\!]) \wedge q = ([\![Background]\!](x)))\}$
where, $\mathcal{A}lt$ is a function that takes an ordinary meaning and returns its alternatives; *Background* is the predicate which when combining with the focus, forms the prejacent.

The lexical entry in (7) was later shown to be inadequate, one of its problems involving plural focused DPs (Rooth 1992, p. 77; Krifka 1993, p. 272). Consider *only John and Bill speak French*. The sentence is a problem for (7): q= *that Bill speaks French* is an alternative not equivalent to the prejacent; yet q cannot be false (as is required by (7)), or the sentence will be a contradiction.

The solution to the plural DP problem leads to a weakening of (7), into (9): since q is entailed by the prejacent, it is not negated by ONLY_{strong}. ONLY_{strong} has later become the standard analysis of English *only*'s assertive component.[4]

(9) $[\![\text{ONLY}_{strong}(\pi)]\!]$ is true iff $\forall q \in C[\pi \not\subseteq q \rightarrow \neg q]$ (Schwarzschild 1994)
Alternatives not entailed by the prejacent are false.

In fact, once pluralities are brought into the picture, (9) can be weakened even further into (10). (10) is what we propose to be the assertive component of *jiu* (note that we do not deny the existence of ONLY_{strong}, which we take to be the correct semantics for English *only* and Mandarin *zhi* 'only', see Sect. 3.2).

(10) $[\![\text{ONLY}_{weak}(\pi)]\!]$ is true iff $\forall q \in C[q \subset \pi \rightarrow \neg q]$
Alternatives asymmetrically entailing the prejacent are false.

Compare (10) with (9): (9) negates all alternative propositions in C that are not entailed by the prejacent, while (10) only negates propositions in C that asymmetrically entail the prejacent. Since the set of propositions asymmetrically entailing the prejacent is a subset of the set of propositions that are not entailed by the prejacent, (10) is weaker.

The weak (10) can still produce an exclusive reading when pluralities are in the alternative set. We show this in the next subsection.

2.1.2 Sum-based alternatives and exclusive jiu

We sketch our assumptions on pluralities first. Following Link (1983), we take the domain of individuals D_e to consist of singular individuals (atoms), and plural ones

[4] (9) is also essentially what Coppock and Beaver (2014, p. 394) posit for the assertive component of *only*. Their lexical entry can be represented by: $[\![\text{ONLY}_{C\&B}(\pi)]\!]$ is true iff $\forall q \in CQ_S[q \rightarrow \pi \geq_S q]$. Taking their CQ_S to be our C and their $\geq_S$ to be entailment (as they suggest later in the paper), their assertive component of *only* is equivalent to (9).

(sums), both being e-type entities. Furthermore, sums are formed out of atoms under the operation of sum-formation $\oplus$. Together, $\langle D_e, \oplus \rangle$ forms a complete atomic join semi-lattice (see Landman 1991 for details).

With sums available, consider *jiu* JOHN *can speak French* in (1). We propose that *jiu* is ONLY_{weak}. Taking the alternative set of JOHN to consist of sums like $j \oplus b$, $j \oplus m \ldots$, we derive the exclusive inference as illustrated in (11).[5]

(11) Jiu JOHN can speak French. (# Bill also can.)
$\mathcal{A}lt_{sum}([\![John]\!])$= $\{j, b, m, j \oplus b, j \oplus m, b \oplus m, j \oplus b \oplus m\}$
π = John can speak French.
Assertion of *jiu* applied to C_{sum}= {~~j, b and m can spk.F~~ $\subset$ ~~j and b can spk.F~~, ~~j and m can spk.F~~ $\subset$ j can spk.F…}
Exclusive Inference b can't spk.F and m can't spk.F.
j can spk.F & $\neg$ (j and b can spk.F) $\Rightarrow$ b can't spk.F
j can spk.F & $\neg$ (j and m can spk.F) $\Rightarrow$ m can't spk.F

In (11), *jiu*'s quantificational domain C_{sum} contains propositions asymmetrically entailing the prejacent, for example, *John and Bill can speak French*; these are the alternative propositions formed by replacing j in the prejacent by one of its sum alternatives that has j as a subpart, and they are negated according to the assertive component of *jiu* as in (10) (crossing-out indicates direct negation by ONLY_{weak}); next, we get the inference that Bill cannot speak French and that Mary cannot speak French, because: *John can speak French*[6] & *it's not the case that (both) John and Bill speak French* $\subseteq$ *Bill cannot speak French*; by parallel reasoning, Mary cannot speak French. We correctly get our exclusive reading that other people (Bill and Mary) cannot speak French.

It's perhaps not surprising that ONLY_{weak} can trigger exclusive inference as ONLY_{strong} is supposed to. After all, the two are equivalent if the quantificational domain C is closed under conjunction (van Rooij and Schulz 2007, p. 197), which is the case for (1)/(11): *can speak French* is a distributive predicate, ensuring*John and Bill can speak French* entails *John can speak French* and *Bill can speak French* (collective predicates will be discussed in Sect. 4.1), and we take the alternative set of JOHN to include all sums that are available in the context, that is, the focus alternative set is cumulative (closed under $\oplus$).

[5] Rooth (1992, p. 83) uses the same mechanism to derive the implicature that Paul didn't pass, from the sentence *Well, I_F passed*. In Rooth (1992), the operation that generates scalar implicature encapsulates our ONLY_{weak}. This is not surprising in view of ONLY_{weak}'s identity to Krifka's (1995, p. 224) SCAL.ASSERT, which is also responsible for scalar implicature generation. But as far as I am aware, ONLY_{weak} has not been proposed as the semantics of any exclusive particle in natural languages and its interaction with non-cumulative sets (see Sect. 2.1.3) has not been explored. On the other hand, the relation between focus particles and scalar implicatures is in fact very tight—witness the Grammatical view of scalar implicatures (Chierchia et al. 2012), where scalar implicatures are generated by application of a covert *only*. Notice the *only* in Chierchia et al. (2012) is ONLY_{strong}. It remains to be seen whether there is any empirical difference between ONLY_{strong} and ONLY_{weak} in the case of scalar implicatures.

[6] This is the prejacent. In the paper, we remain neutral on whether the prejacent is presupposed or asserted. See Horn (2009) for a recent overview of the complexity of the issue (for *only*). For expository purposes, we treat the prejacent as an assertion.

On the other hand, ONLY_{weak} differs from ONLY_{strong} if C is not closed under conjunction. This happens when all the alternatives are *atoms*. In such cases, ONLY_{weak} does not trigger exclusivity and a non-exclusive *jiu* obtains.

2.1.3 Atoms-based alternatives and non-exclusive jiu

Our second example (2) involves a non-exclusive *jiu*, as it can be felicitously followed by *Bill also can*, as in (12).

(12) YUEHAN jiu hui shuo fayu, Bill ye hui.
John JIU can speak French, Bill also can
'John, who is easy to get hold of, can speak French; Bill also can.'

(12) is naturally used in a context where A asks *Who can speak French? I am looking for someone for language help*. In such a context, B can use (12) as a felicitous answer if John is familiar to both A and B, and is easy to get hold of (For example, John is A and B's roommate). In this case, we are evaluating (atomic) individuals' accessibility to the interlocutors; thus, it is reasonable to take the alternatives to *John* to be *Bill, who is the addressee's friend in the French department*, *a real Frenchman such as the president of France*….

Now, with all focus alternatives being atomic individuals, the result of applying *jiu* (=ONLY_{weak} (10)) does not deliver an exclusive meaning. Consider in this case *jiu*'s quantificational domain C_{atom} = {John can speak French, the addressee's friend Bill in the French department can speak French, the president of France can speak French…}; since there are no propositions in C_{atom} that asymmetrically entails the prejacent, the application of *jiu*, which according to (10) only negates alternatives asymmetrically entailing the prejacent, is trivial, and non-exclusive *jiu* obtains. This is sketched in (13).

(13) JOHN jiu can speak French, (Bill also can.)
$\mathcal{A}lt_{atom}(\llbracket John \rrbracket)$= {*our roommate John, the addressee's friend in the French department Bill, the President of France, …*}
$\boldsymbol{C}_{atom}$= {John can spk.F, the addressee's friend in the French department can spk.F, the president of France can spk.F…}
Assertion of *jiu* applies vacuously since there are no stronger proposition in C_{atom}.

It's time to take stock: we have proposed a semantics for *jiu* (ONLY_{weak}) that is weaker than the standard semantics of English *only* (ONLY_{strong}). We have further posited two types of alternative sets: alternative sets based on *sums* and those based on *atoms*. Since ONLY_{weak} is 'super-alternative-sensitive', it gives rise to an exclusive meaning when it operates on sum-based alternative sets, but becomes non-exclusive when the alternative set is atom-based. In this way, the 'ambiguity' of *jiu* is explained.

In the next subsection, we will use the same mechanism to derive facts about *dou*, which is claimed to be 'ambiguous' between *even* and a distributive operator similar to VP-*each*. Crucially, we will stay with the two types of alternative sets (sums vs.

atoms) posited for the analysis of *jiu*, and show how they can be associated with a single *dou* and derive the right set of facts.

2.2 *Dou* as *even*

Unlike *jiu*, *dou* is well discussed in the literature (Lee 1986; Cheng 1995, 2009; Shyu 1995; Huang 1996; Lin 1998; Hole 2004; Chen 2008; Liao 2011, a.o.). Instead of reviewing/answering all the empirical and theoretical questions raised in the literature, we will first start with the most basic facts concerning *dou*, and show how a unified analysis of *dou* can be developed. Discussion of more complicated data is postponed to Sects. 3 and 4.

2.2.1 Basic facts

Our (3) and (4) (repeated here as (15) and (14)) from the very beginning of the paper illustrate the two 'uses' of *dou*.

(14) YUEHAN dou mai le yi liang chezi.
John DOU buy ASP one CL car
'Even John bought a car.' *'even'*

(15) TAMEN dou mai le yi liang chezi.
they DOU buy ASP one CL car
'They each bought a car.' *distributive operator*

In (14), *dou* adds an *even* flavor, and the sentence conveys that John's purchasing a car is less likely/more noteworthy than other people buying a car. On the other hand, (15) has an *even*-less interpretation (with stress on *dou*[7]), and the *dou* forces a distributive reading: they each bought a car. (16) is the generalization.

(16) ***dou*'s distributive effect**
Even-less *dou* forces distributive readings.

The generalization in (16) is implicitly assumed by most analyses of *dou*. Take Lin (1998) as an example; Lin discusses only distributive-*dou* without mentioning *even-dou* in his paper. The latter seems to him to be a different, homophonous item from the former (though there is no a priori reason for doing so). Thus, Lin's generalization that

[7] A reviewer questions our alternative-based account of *dou* to be presented below based on the fact that distributive-*dou* often bears stress while the alternative triggers we posit sometimes do not. While we think getting stress patterns right is important, not receiving stress does not mean not triggering alternatives: there are *second occurance focus* (Partee 1999) that never receives the main stress but triggers alternatives, and *stressed additive particles* (Krifka 1998) that themselves receive stress but are associated with alternative-triggering items. More generally, alternative semantics has become a useful theoretical tool employed to explain a large variety of phenomena such as questions, scalar implicatures, polarity sensitive items, *wh*-indeterminates and so on. Our account follows this tradition and we have to leave how Mandarin alternative triggers get phonetically realized to another occasion. See Liao (2011: Sect. 4.3.2) for evidence supporting the claim that distributive *dou* is alternative-sensitive.

distributive-*dou* (or equivalently, the *dou* that is not the *even-dou*) forces distributive readings is equivalent to (16).

The rest of Sect. 2.2 is devoted to deriving (16). Before we spell out the details, it might be useful to note that our proposal involves a change of perspective: instead of focusing on how distributive readings are forced by distributive-*dou*, as usually seen in the literature, we focus on how the *even*-flavor can disappear when a distributive reading is present.

2.2.2 Towards an analysis

We first introduce the ingredients needed to derive (16), specifically: a semantics of *dou* equal to English *even*, a covert distributive operator generating distributive readings, and a group operator responsible for collective readings.

We propose that *dou* has the semantics of English *even*, as proposed in Karttunen and Peters (1979) (cf. Liao 2011, p. 217): *dou* is truth conditionally vacuous but presupposes that its prejacent is the most unlikely proposition among its alternatives (17) (we set aside the additive presupposition of *even*).

(17) $[\![dou(\pi)]\!]$ is defined iff $\forall q \in C[\neg(\pi = q) \rightarrow \pi \prec_{likely} q]$
if defined, $[\![dou(\pi)]\!] = [\![\pi]\!]$

With (17), the *even-dou* in (4)/(14) is straightforwardly captured.

As is mentioned in Sect. 2.2, we follow Link's (1983) theory of plurality where the domain of individuals consists of *sums* and *atoms*. We also adopt Landman's (1989) group operator $\uparrow$ which turn sums into atoms. In (18), both z and $\uparrow (z \oplus l)$ are atoms: they either have no proper parts (pure atoms) or have proper parts that are not linguistically accessible for predication (groups).

(18) a. $[\![\text{Zhangsan}]\!] = z$ Pure atom
b. $[\![\text{Zhangsan and Lisi}_{sum}]\!] = z \oplus l$ Sum
c. $[\![\text{Zhangsan and Lisi}_{group}]\!] = \uparrow (z \oplus l)$ Group/impure atom

Next, distributive readings are analyzed by a covert distributive operator (19) on VP (Link 1983), while (thematic) collectivity involves predication over *groups* Landman (1996, 2000) (see also Chierchia 1998, p. 64; Champollion 2010, p. 210).

(19) $[\![Dist]\!] = \lambda P \lambda x \forall y[(y \leq x \ \wedge \ Atom(y)) \rightarrow P(y)]$

(20) a. lift this piano$(\uparrow (z \oplus l))$ Collective
b. $Dist$(lift this piano)$(z \oplus l)$ Distributive

(20) illustrates how the system works. To combine the VP *lift this piano* with *Zhangsan and Lisi*, we can either apply the group operator to the DP as in (20a) or apply the distributive operator to the VP as in (20b). The former gives a collective reading, the latter a distributive one.

The existence of a covert distributive operator in Mandarin Chinese is independently justified by (21a) where *dou* is absent but a distributive reading is possible and strongly preferred for every speaker consulted. In this respect, our judgment agrees with Xiang

(2008, p. 229), but differs from Lin (1998, p. 201), who claims that (definite) plurals in Mandarin do not have distributive readings, unless *dou*, according to Lin a distributive operator, is added. However, it seems that Lin did not take context into consideration. For (21a), even Lin himself (personal communication) agrees that a distributive reading is the preferred one. Below, (21b) and (21c) spell out the LF and semantics of (21a).

(21) a. (Context: I asked who among the kids drew two pictures; you replied:)
Zhangsan he Lisi hua le liang fu.
Zhangsan and Lisi draw ASP two CL
'Zhangsan and Lisi each drew two pictures.'
b. [$_{TP}$ Zhangsan and Lisi [$_{VP}$ $Dist$ [$_{VP}$ drew two pictures]]]
c. $\forall y[(y \leq z \oplus l \wedge Atom(y)) \rightarrow \exists X[|X| = 2 \wedge \mathsf{pics}(X) \wedge \mathsf{draw}(y, X)]]$

Finally, we integrate Link–Landman's theory of pluralities into Rooth's theory of alternatives. We propose that a sum has other sums (including pure atoms) as its alternatives (22a), while a group has as its alternatives other groups, as in (22b) ($\uparrow(z) = z$, Landman (2000, p. 100)).

(22) a. $\mathcal{A}lt_{sum}(z \oplus l) = \{z \oplus l, z, l, z \oplus w \ldots\}$
b. $\mathcal{A}lt_{atom}(\uparrow(z \oplus l)) = \{\uparrow(z \oplus l), \uparrow(z), \uparrow(z \oplus w) \ldots\}$

Together with our assumptions on alternatives of pure atoms like $john$ discussed in Sect. 2.1, repeated here as (23), they illustrate the main theme of the paper—varieties of alternatives.

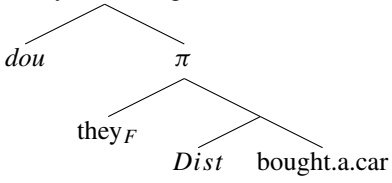
(23) a. $\mathcal{A}lt_{sum}(j) = \{j, z, j \oplus z \ldots\}$
b. $\mathcal{A}lt_{atom}(j) = \{j, z, \ldots\}$

Now we are ready to explain the distributive effect of *dou* (16).

2.2.3 Sum-based alternatives and distributive-dou

Dou's distributive effect (16) states that *even*-less *dou* forces distributive readings. An equivalent way of saying (16), as hinted at the end of Sect. 2.2.1, is that (a) *dou*'s *even* flavor can disappear in distributive contexts, and (b) it cannot disappear in collective contexts. In this subsection we focus on explaining (a), and following the literature we call *even*-less *dou* distributive-*dou*. Now consider a distributive-*dou* example (24a), repeated from (3)/(15).

(24) a. TAMEN dou mai le yi liang chezi.
they DOU buy ASP one CL car
'They each bought a car.'
b.



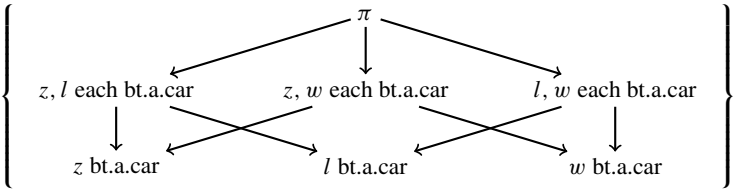
We propose that (24a) has the analysis in (24b). Here, *dou* takes sentential scope,[8] and a covert distributive operator is present, giving rise to the distributive reading.

Supposing now that Zhangsan, Lisi and Wangwu are the individuals in the context and *they* refers to the sum $z \oplus l \oplus w$, we have (25) as $they_F$'s alternative set, (26) the prejacent and (27) the propositional-level alternative set C_{sum}.

(25) $\mathcal{A}lt([\![they_F]\!]) = \{z, l, w, z \oplus l, z \oplus w, l \oplus w, z \oplus l \oplus w\}$

(26) $\pi = \forall y[(y \leq z \oplus l \oplus w \ \wedge \ Atom(y)) \rightarrow \exists x[\mathsf{car}(x) \wedge \mathsf{bought}(y, x)]]$
In words: z, w, l each bought a car.

(27) $C_{sum} =$



Note that the propositions in C_{sum} stand in a very interesting relation: *dou*'s prejacent π logically (asymmetrically) entails all the other alternatives.

We have proposed that *dou* is *even*, whose semantics requires that the prejacent π be less likely than all π's alternatives. But entailment is stronger than likelihood: if p entails q, p is at least as unlikely as q (Lahiri 1998; Crnič 2014, Sect. 2.1). Thus, the *even*-presupposition of *dou*, which essentially is a requirement on the shape of its C_{sum}, is weaker than what we already know about the C_{sum} as in (27) and is automatically satisfied.[9] In this case, the *even*-meaning is trivial (Liao 2011). In other words, when the alternatives of *dou*'s prejacent are based on sums, *dou*'s *even* flavor can be trivialized by a distributive operator. This I claim is how *dou*'s *even* meaning could disappear in a distributive context.

It needs to be noted that the *even*-presupposition of *dou* in a distributive context cannot possibly be met, let alone be met automatically, unless the referent of *dou*'s associate is the maximal among its alternatives. This is what I call *dou*'s maximality effect (28).

(28) ***dou*'s maximality effect**
Even-less *dou* requires maximality of *dou*'s associate.

(28) is a theorem in our proposal. Here is its explanation: let the prejacent of a *even*-less *dou* be $\mathsf{P(a)}$, P being the predicate, a the associate of *dou*; if a were not the maximal individual among its alternatives there would be at least one proposition $\mathsf{P(b)}$ in C_{sum} based on a more inclusive sum b that asymmetrically entails the prejacent (based on distributivity of P, see (16)); since unlikelihood respects entailment (if p entails q, q

[8] This could be achieved either by movement of *dou*, similar to movement of *even* (Karttunen and Peters 1979; Lahiri 1998; Crnič 2014, Sect. 2.3), or by making *dou* an indicator of a covert *even* that has sentential scope (Liao 2011, p. 215). In the latter view, *dou* does not have its own meaning. In the paper, we adopt the movement view, but nothing crucial hinges on this.

[9] We also need to assume that non-equivalent propositons within C_{sum} have different likelihood, which I take to be satisfied by normal contexts.

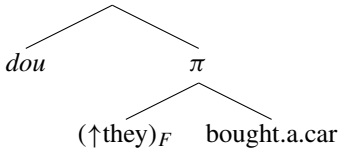
cannot be more unlikely than p), P(a) cannot be the most unlikely proposition within the alternative set, this contradicts *dou*'s presupposition, and thus a has to be maximal. (28) is explained.

The maximality effect of *dou* will later be discussed in Sect. 2.4.3 and especially Sect. 4.3, when we compare our analysis with proposals that treat *dou* as a maximality operator (Giannakidou and Cheng 2006; Xiang 2008).

2.2.4 Atom-based alternatives and even-dou

We now consider *dou* associated with atom-based alternative sets, where there is no entailment relation within the C_{atom}. For instance, under a collective construal of (24a), whose LF being (29), *dou*'s prejacent does not entail its alternatives (*that z and w together bought a car* has nothing to do with *that w and l together bought a car*); thus the *even*-presupposition of *dou* is not trivial and it surfaces. This is indeed a possible interpretation of (24a), which means that even they (as a very poor couple) together bought a car.[10]

(29)



The same thing happens with pure atoms as in (30), repeated from (3)/(14).

(30) YUEHAN dou mai le yi liang chezi.
John DOU buy ASP one CL car
'Even John bought a car.' *'even'*

(31) summarizes our discussion of *dou*: *dou* is always *even*; distributive-*dou* is just a trivialized-*even-dou*. Since trivialized-*even-dou* happens only if *dou* is associated with a sum-based alternative set and a *Dist* is present, we have the correlation between *dou* and distributivity, i.e., *dou*'s distributive effect (16).

(31)

Alternatives	*dou*	Explanation
Sums	distributive-*dou*	*even* trivialized by *Dist*
Pure atoms	*even-dou*	No entailment, no trivialization
Groups	*even-dou*	No entailment, no trivialization

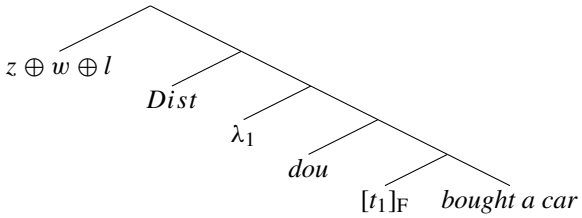
Two points need mentioning. First, a reviewer correctly points out that *dou* is compatible with certain 'collective' predicates such as *be classmates*, without necessarily having the *even*-flavor. The reviewer takes this to be our problem: if collective predicates do not license entailment down to subgroups, how could the *even*-presupposition of *dou* be trivially satisfied? However, it turns out that *be classmates* is not a real collective predicate. It licenses what Dowty (1987) calls *distributive sub-entailments*. Regardless of how *be.classmates*-type predicates are analyzed (see Champollion 2015

[10] This reading has been noted, for example, by Chen (2008, p. 65) and Liao (2011, p. 220).

for a recent analysis compatible with our proposal), the distributive sub-entailment property will make *that X, Y and Z are classmates* entail *that Y and Z are classmates*; this trivializes *dou*'s *even* flavor, if *X, Y and Z* is the maximal individual in the context, with its alternatives being *X and Y*, *X and Z* and so on. Crucially, for genuine collective predicates such as *be numerous* that do not distribute at all, *dou* necessarily adds the *even* flavor, as predicted.

Second, our proposal only states that *dou*'s *even*-presupposition *can* be trivialized by a distributive operator, but it does not have to be. Specifically, trivialization happens when *dou* scopes over $Dist$ (see (24b)), but the other option ($Dist > dou$) is also available in our system (32).

(32)



In (32), since there is no $Dist$ below *dou* to trivialize its *even* presupposition, (32) corresponds to the meaning that for each of Zhangsan, Wangwu and Lisi, it was unlikely for him to buy a car, but each of them bought one, which is a combination of distributive reading with *even* flavor.[11]

2.3 Summary

It's time to take stock. We have identified two varieties of alternatives: sum-based ones and atom-based ones; we have also assigned single unambiguous semantics to both *jiu* and *dou*: *jiu* as ONLY_{weak} and *dou* as *even*. The two aspects of our proposal interact, generating the matrix in (33) and capturing apparent 'ambiguities' of the two FPs.

(33)

	jiu = ONLY_{weak}	*dou* = *even*
Alternatives of Sums	exclusive *jiu*	distributive-*dou*
Alternatives of Atoms	nonexclusive *jiu*	*even-dou*

In (33), it is important to note that we have two cases of trivialization: when *jiu* is associated with a set of atomic alternatives, its exclusive meaning is trivialized (because there is no proposition asymmetrically entailing the prejacent within C_{atom} for ONLY_{weak} to negate); when *dou* is associated with a set of sums (with the prejacent

[11] The technical details of (32) are not trivial. It involves focused bound pronouns/variables. A similar situation happens with *functional/pair-list* readings in questions with quantifiers. I believe Chierchia's (1992) functional trace (following Engdahl 1986) can be used here. Specifically, we can take the trace in (32) to consist of an identity function combining with t_1, with $_F$ on the identity function. An alternative suggested by the editor is to extend Rooth's semantics so as to treat variables just like other expressions of type e, but the difficulty lies in how to contextually restrict these alternatives. We have to leave this to another occasion.

involving the maximal sum), its *even* meaning is trivialized (because the preajcent entails all the other propositions in C_{sum}).

There are two questions about trivialization. First, is it ever possible for an FP such as *only* to have no semantic effect? If yes, then the second question is: if an environment makes an FP vacuous, why do we want to keep the FP in that environment? The next subsection will clarify these issues.

2.4 Trivialization

2.4.1 Trivialization in the alternative-exhaustification approach

Our answer to the first question is: yes, trivialization is possible. It actually plays a very important role in the alternatives-&-exhaustification approach to (weak) NPIs as in Krifka (1995) and Chierchia (2013).

The basic fact about NPIs like English *any* (setting aside free choice *any*) is that they are only grammatical in downward entailing contexts such as in the scope of negation (34).

(34) a. *John met any student.
b. John didn't meet any student.

According to the alternatives-&-exhaustification approach in Chierchia (2013), *any student* is a special existential quantifier with a domain of quantification D (35). The difference between *any student* (under an NPI use) and a plain indefinite *a student* is that only the former obligatorily activates alternatives, which are also existentials but with domains being subsets of D (36).

(35) $[\![\text{any student}_D]\!] = \lambda P \exists x \in [\![D]\!][\mathsf{student}(x) \wedge P(x)]$

(36) $\mathcal{A}lt([\![\text{any student}_D]\!])$
$= \{\lambda P \exists x \in [\![D']\!][\mathsf{student}(x) \wedge P(x)] : [\![D']\!] \subseteq [\![D]\!]\}$

Alternatives, once activated, must be *exhaustified*. Chierchia proposes that the alternatives to *any student* are exhaustified by a covert *only*, which semantically equals to our ONLY_{strong}. With ONLY_{strong}, (34) has the following analyses.

(37) ONLY_{strong} [John met any$_D$ student]
Prejacent: John met a student in D.
Applying ONLY_{strong}: $\forall D' \subseteq D$,John didn't meet a student in D'.

(38) ONLY_{strong} [John didn't meet any$_D$ student]
Prejacent: John didn't meet a student in D.
Application of $\text{ONLY}_{strong}$is trivial.

It turns out that a computation of the meaning of (37) returns a contradiction, because: John met a student in D (the prejacent) entails there is a $D' \subset D$ such that John met a student in D', which contradicts the result of applying ONLY_{strong}, according to which John didn't meet a student for all (strict) sub-domains of D. This contradiction

explains why *any* cannot be used in a positive context (and in other upward entailing contexts).

On the other hand, in (38), the application of ONLY_{strong} does not cause a problem, because the prejacent (that John didn't meet a student in D) now entails all the other alternatives (that John didn't meet a student in D', where $D' \subseteq D$). Applying ONLY_{strong} simply returns the prejacent and no contradiction results. This explains why *any* can be used under negation (and in other downward entailing contexts).

Crucially, trivialization of the covert *only* (= ONLY_{strong}) has to be granted to make sure (38) is semantically well-formed.

We take Chierchia's analysis of weak NPIs to be correct, and it shows that there is no principled constraint in the grammar that forbids trivialization of a certain semantic effect of an FP.

Now we turn to the second question raised at the end of Sect. 2.3, which asks what contribution a trivialized FP brings to a sentence. Notice that for Chierchia, the function of the trivialized covert *only* is to exhaustify the alternatives triggered by an NPI, in syntactic parlance, to check the inherent focal feature of the NPI.

Instead of resorting to syntax, we propose that *jiu* and *dou*, even after trivialization, are actually not semantically vacuous. *Jiu* contributes a scalar presupposition, while *dou* gives rise to a maximality effect.

2.4.2 Jiu's scalar presupposition

We have mentioned the scalar low-rank reading of *jiu*. For example, our non-exclusive *jiu* example, repeated here as (39), has a scalar low-rank reading: (our roommate) John is easy to get hold of. This scalar reading can be seen as coming from a presupposition of *jiu*[12]; thus, even though the assertive component of *jiu* (the exclusive part) can be trivialized, by contributing the scalar presupposition *jiu* is still not entirely vacuous.

(39) (Women.de shiyou) YUEHAN jiu hui shuo fayu.
(our roommate) John JIU can speak French
'Our roommate John, who is easy to get hold of, can speak French.'

To formally represent the scalar reading, we assign *jiu* a presupposition that requires *jiu*'s associate to be ranked lower on a scale R than its other alternatives. Formally, this is represented in (40).

(40) Scalar Presupposition of *jiu*
$\forall x \in \mathcal{A}lt([\![Associate]\!])[x \neq [\![Associate]\!] \rightarrow [\![Associate]\!] <_R x]$

(41) Scalar Presupposition of *even*
$\forall q \in \mathcal{A}lt([\![Prejacent]\!])[q \neq [\![Prejacent]\!] \rightarrow [\![Prejacent]\!] <_{likely} q]$

[12] It is a presupposition because it projects over yes-no questions, possibility modals and antecedents of conditionals. For example: *It's possible that* [JOHN JIU *can speak French*] carries the inference that John is easy to get hold of.

(40) follows a common way of capturing the scalar presuppositions of scalar FPs like *even* (Karttunen and Peters 1979) and *already/still* (Krifka 2000).[13] To take *even* for instance, the only difference between (40) and (41) is that the former ranks individuals while the latter propositions. By ranking the prejacent of *even* as the bottom of a likelihood scale we obtain the inference that the prejacent is the least likely. Similarly, by ranking John as the bottom of an *effort* scale, we obtain the inference that John is easy to get hold of.[14]

Exclusive *jiu* is also scalar.[15] For example, [*jiu* John$_F$ can speak French] (=(1)) carries the implication that the sum of people that can speak French is small in number. We can capture this inference by ranking *John* on an individual part-of scale (Link 1983) $j < j \oplus b$, $j \oplus m < j \oplus b \oplus m$.[16]

2.4.3 Dou's maximality effect

After showing the non-vacuity of trivialized *jiu*, we turn to trivialized *dou* now. In our proposal, distributive-*dou* results from trivialization of its *even*-flavor by a distributive operator within its scope. However, trivialized *dou* is not entirely vacuous; it gives rise to the maximality effect in (28), explained at the end of Sect. 2.2.3.

We can observe the maximality effect of *dou* in listing contexts (42a).

[13] Krifka (2000) is interested in German *schon/noch* 'already/still', which contribute *early/late* scalar inferences. Krifka's way of capturing these scalar inferences is exactly like our (40). For example, *schon* is truth-conditionally vacuous but presupposes that its associate is ranked earlier than all the other alternatives.

[14] We are here actually using a superlative semantics to capture an evaluative intuition, which is not quite right. To witness, that John is lower than any of its alternatives on an effort scale does not mean getting hold of John is easy (perhaps all of them are difficult to get hold of), just as John is the tallest does not mean John is tall. To fix this, we posit a requirement (i) which says that the context dependent expected value s_c (Kennedy 1999) should always be included in the restricted alternative set induced by *jiu*. Intuitively, this is plausible, since the restricted alternative set tries to capture the idea of *alternatives under consideration* (Krifka 2000), and the expected value seems to always qualify as one of them.

(i) *Expected value always under consideration*
$\exists x \in \mathcal{A}lt([\![\alpha]\!])[x \neq [\![\alpha]\!] \wedge \mu_{\mathrm{R}}(x) = s_c]$

[15] For the scalarity of English *only*, see Zeevat (2008), Klinedinst (2005), and Coppock and Beaver (2014). (i) below shows that exclusive *jiu* and *only* both contribute a scalar low-rank inference.

(i) (**jiu*/*only) 10 people came, which was a lot.

(i) without *jiu* is good because 10 people can either be many or few, depending on the context. (i) with *jiu* sounds contradictory because *jiu* carries a scalar meaning that the people that came were few, which contradicts the content of the following relative clause.

[16] Reducing the complete set $\{j, b, m, j \oplus b, j \oplus m, b \oplus m, j \oplus b \oplus m\}$ as in (11) to $\{j, j \oplus b, j \oplus m, j \oplus b \oplus m\}$ does not affect the exclusive inference. The reader can verify this by running the computation in (11), or by simply observing the cumulativity of the latter set.

(42) a. Zhexie haizi zhong, Yuehan he Lisi (*? dou) hua le yi fu hua, these kids among, John and Lisi DOU draw ASP one CL picture, Zhangsan he Mali (*? dou) hua le liang fu, Wangwu he Bier (*? Zhangsan and Mary DOU draw ASP two CL, Wangwu and Bill dou) hua le san fu.
DOU draw ASP three CL
'Among these kids, *j* and *l* each drew one picture, *z* and *m* each drew two, and *w* and *b* each drew three pictures.'

b. Zhexie haizi dou hua le liang fu hua.
these kids DOU draw ASP two CL picture
'These kids all drew two pictures'.

Suppose that for each of these kids, you wonder how many pictures s/he drew. A listing sentence such as (42a) cannot have distributive *dou* in each of its conjuncts. This can be seen to follow from *dou*'s maximality effect: since none of the conjuncts involves the maximal sum among the individuals under discussion, which in the current context is *these kids in their entirety*, none of them allows *even*-less *dou*. (42a) contrasts with (42b), which involves predication over the maximal sum and thus allows distributive *dou*. In this case, *dou* simply adds the presupposition that *these kids* are all the individuals that are under current discussion, which is satisfied in the context described above.

Overall, while we think trivialization of certain semantic components of an FP is in general not ruled out by the grammar, we agree that having an entirely semantically-vacuous FP within a sentence needs motivation. However, we have shown that trivialized *jiu* and *dou* are not vacuous: *jiu* always conveys a low-rank reading, and *dou* gives rise to a maximality effect. While the low-rank meaning needs to be built into the lexical entry of *jiu* as a scalar presupposition, the maximality effect of *dou* naturally follows from our proposal of *dou* as *even*.

3 Regulating ambiguities

Our proposal is capable of deriving systematic 'ambiguities'. However, not every sentence containing an FP is ambiguous and not every FP has multiple 'uses'. This section is devoted to regulating ambiguities by independently motivated principles and proposals.

3.1 Contrastive topic and Maximize presupposition

A single *jiu*-sentence is not ambiguous. Consider (1)–(2) (repeated here as (43)–(44)), neither of the sentences is ambiguous: (43) has to be exclusive while (44) nonexclusive. Syntax seems to matter. Specifically, we have (45) as the generalization (Hole 2004, p. 8): exclusive *jiu* appears to the left of its associate while non-exclusive *jiu* appears to the right.

(43) Jiu YUEHAN hui shuo fayu.
JIU John can speak French
'Only John can speak French.' (# Bill also can.)

(44) YUEHAN jiu hui shuo fayu.
John JIU can speak French
'John, who is easy to get hold of, can speak French.' (Bill also can.)

(45) The *jiu* generalization
a. *jiu* > Associate → Exclusive
b. Associate > *jiu* → Non-exclusive

This is a potential problem because in our story *John* can either trigger a sum-based alternative set or an atom-based one; without any constraint, we predict that both (43) and (44) can be exclusive or non-exclusive, depending on the choice of the alternative set. This is the *over-generation* problem of *jiu*.

To solve the over-generation problem and explain (45), we need to add some constraints into our account. Two independently motivated constraints will be discussed below.

The first constraint has to do with *constrastive topics*. We propose that post-*jiu* associates are foci, while pre-*jiu* associates are contrastive topics (CT). Since CT carries an anti-exhaustive requirement (Büring 1997; Krifka 1998; Hara 2005; Wagner 2012), it is incompatible with an exclusive construal of *jiu*.

Before we spell out the details of this proposal, it needs to be mentioned that the idea of FPs associating with (contrastive) topics is well discussed in the syntactic literature of Mandarin (Shyu 1995; Hole 2004, a.o.). We are here simply adding a semantic aspect to the idea.

We take CTs to be alternative-triggering topics with certain pragmatic effects such as anti-exhaustiveness as in (46).[17] CTs are similar to foci in that both of them trigger (flat) alternatives, their differences mainly being syntactic (scope) and pragmatic (anti-exhaustiveness) (Tomioka 2010; Wagner 2012).

(46) $[\![\text{CT}(\pi)]\!]$ is defined only if $\exists q \in C[\pi \not\subseteq q \wedge \Diamond q]$
if defined, $[\![\text{CT}(\pi)]\!] = [\![\pi]\!]$
In words: a sentence π containing a CT presupposes that an alternative q not entailed by π is possibly true. Wagner (2012), p. 46

Now consider (44) with the CT marking as in (47).[18]

[17] A reviewer suggests the anti-exhaustiveness of CT in (46) be replaced by a ¬∀-presupposition proposed in Hole (2004), and it can be built into the lexical meaning of *jiu*. A ¬∀-presupposition says there is an alternative proposition in C being false. While we agree that a ¬∀ inference might be real in certain [CT + *jiu*] cases, it is independent of anti-exhaustiveness, cancellable and thus can be derived as Gricean implicatures (cf. Büring 2003, p. 523).

[18] We assume that in (47) the CT stands on its own with no free focus below it (cf. Constant's (2014) lone CT). This is supported by the fact that in (47) nothing below *jiu* can be stressed: if, for example, *fayu* 'French' gets stress, *jiu* will obligatorily associate with it instead of associating with the CT *John* (but an explanation of this fact has to be left for another occasion). In (47), we further assume that *jiu* covertly moves

(47) YUEHAN$_{CT}$ jiu hui shuo fayu.
John JIU can speak French
'John, who is easy to get hold of, can speak French.'(Bill also can.)

In (47), in keeping with the idea of varieties of alternatives, *John*$_{CT}$ can either trigger a sum-based alternative set or an atom-based one. However, the former, associated with *jiu* (=ONLY$_{weak}$), obligatorily activates an exclusive inference that other people cannot speak French, which contradicts the anti-exhaustive presupposition of CT that it is possible that other people can also speak French. On the other hand, with an atom-based alternative set, no exclusive inference is triggered, and thus CT is compatible. In general, only atom-based alternative sets and the ensuing nonexclusivity are allowed when *jiu*'s associates appear before *jiu* as a CT. This, I submit, explains (45b) and the non-ambiguity of (44)/(47).

Now let us consider (43), repeated here with focus marking as (48). (48) is also unambiguous, but CT has no jurisdiction here.

(48) Jiu YUEHAN$_{F}$ hui shuo fayu.
JIU John can speak French
'Only John can speak French.' (# Bill also can.)

We suggest that the non-ambiguity of (48) results from a competition of (48) and its CT counterpart (47). Roughly, to generate a non-exclusive *jiu*-sentence, we prefer to choose the more specialized CT rather than focus.

Specifically, the competition between (48) and (47) is an instance of *Maximize Presupposition* (Heim 1991), which says: in certain cases, when two sentences have the same assertive information, only one of them, that is, the one with stronger presuppositions, can be felicitously used.

Consider (48). Given varieties of alternatives, *John*$_{F}$ can either generate a sum-based alternative set or an atom-based one. The latter, when combined with *jiu*, does not give rise to an exclusive inference. In this case, the resulting assertive component (*that John can speak French*) is equivalent to that of (47). However, (47) has an extra anti-exhaustive presupposition contributed by its CT, and consequently it blocks its focus counterpart by Maximize Presupposition. On the other hand, when *John*$_{F}$ takes up a sum-based alternative set, *jiu* will trigger an exclusive inference, which its CT counterpart cannot have because of anti-exhaustiveness. Thus, the two will not share the same assertive information and Maximize Presupposition does not have a say. This, I claim, explains (45a) and why (48) is exclusive but not ambiguous.

Summarizing our discussion so far, we have introduced two independently motivated constraints—the anti-exhaustiveness of CT and Maximize Presupposition—into our system. The former militates against exclusive *jiu* with CT, while the latter blocks non-exclusive *jiu* with focus. This is shown in (49).

Footnote 18 continued
across the CT to have sentential scope, similar to *even*-movement (see footnote 8); then the alternatives triggered by CT make up the quantificational domain *C* of both *jiu* and CT, in the style of (8).

(49)

	jiu = ONLY$_{weak}$	CT/Focus	Result
Sum-alternatives	exclusive	pre-*jiu* CT	Contradiction
Atom-alternatives	nonexclusive	pre-*jiu* CT	√
Sum-alternatives	exclusive	post-*jiu* Focus	√
Atom-alternatives	nonexclusive	post-*jiu* Focus	Blocking

The above ideas make several predictions. First, since topicalization is a common way of creating topics in Mandarin, topicalization of alternative-triggering items is expected to create CTs. Thus, we predict that topicalization of *jiu*'s associate makes the sentence nonexclusive. This prediction is borne out by (50)–(51).

(50) Yuehan jiu kan-guo AoManYuPianjian$_F$.
John only read-ASP Pride.and.Prejudice
John has only read Pride and Prejudice.
Impossible continuation: # he probably has also read Emma.

(51) AoManYuPianjian$_{CT,1}$ Yuehan jiu kan-guo t_1.
Pride.and.Prejudice John JIU read-ASP
As for Pride and Prejudice, John has read it.
Possible continuation: he probably has also read Emma.

The only difference between (50) and (51) is topicalization, but (50) is exclusive while (51) not. This seemingly surprising fact follows naturally from our proposal: (51) has to be nonexclusive because of the CT effect, while (50) has to be exclusive because of its CT counterpart and Maximize Presupposition.

The second prediction is a syntactic one. We mentioned earlier that pre-*jiu* associates are topics while post-*jiu* associates are foci. Combining this claim with the generally held assumption (Shyu 1995; Paul 2005, a.o.) that topic and focus have different structural positions in Mandarin, we predict the two instances of *John* in (47)–(48) occupy different syntactic positions. This is also a correct prediction, evidenced by placement of sentential adverbs (52)–(53).

(52) {**jingran**} [$_{TP}$ jiu Lisi$_F$ {***jingran**} hui shuo fayu].
surprisingly JIU Lisi surprisingly can speak French
'Surprisingly, only Lisi can speak French.'

(53) {**jingran**} [$_{TopicP}$ Lisi$_{CTi}$ {**jingran**} [$_{TP}$ jiu t_i hui shuo fayu]].
surprisingly Lisi surprisingly JIU can speak French
'Surprisingly, Lisi, who is easy to get hold of, can spk.F.'

(52) illustrates that sentential adverbs such as *jingran* 'surprisingly', *mingxian* 'obviously' and yes-no question operator *shi-bu-shi* 'be-not-be' cannot appear after post-*jiu* associates. To add a sentential adverb, the adverb has to appear before *jiu*. In contrast, sentential adverbs have no problem following the *Lisi* in (53), which is a pre-*jiu* associate. These facts are explained if we assume that post-*jiu* associates are within TP where sentential adverbs (which we take to reside at left-periphery positions) cannot occur, while pre-*jiu* associates have moved out of TP to Spec TopicP, a Topic position.

Finally, it needs to be emphasized that our proposal in this subsection not only makes sure that the *jiu* in a [Associate > *jiu*] sentence is nonexclusive; it makes a stronger prediction: the entire sentence is anti-exhaustive, because of the CT status of the associate. This is a correct prediction. Consider (54) (built on Tomioka 2010, p. 7).

(54) A: Among John, Bill and Mary, who won?
B: #Yuehan$_{CTi}$ jiu ying le.
John JIU win ASP
Intended: 'John, who is very salient in the context, won.'

In (54), B's answer is infelicitous because A's question carries a presupposition that there is only one winner in a match (due to world knowledge), which contradicts the anti-exhaustive presupposition of the CT. (54) supports our strategy of using CT as an independent factor triggering anti-exhaustiveness, and thus forbidding *jiu* to be used exclusively.

3.2 Strong *only*

Not every FP is 'ambiguous'. There is a second ONLY in Mandarin—*zhi*, which is always exclusive. It is not 'ambiguous' because its semantics is not sensitive to the sum-atom distinction of its alternative sets.

First, *zhi* can usually be used interchangeably with exclusive *jiu* (55).

(55) Yuehan zhi/jiu kan-guo AoManYuPianjian$_F$.
John only read-ASP Pride.and.Prejudice
John has only read Pride and Prejudice.
Impossible continuation: # he probably has also read Emma.

However, *zhi* does not allow association to its left.[19] For example, topicalization of *zhi*'s associate leads to ungrammaticality (56).

(56) *AoManYuPianjian$_{CT,1}$ Yuehan zhi kan-guo t_1.
Pride.and.Prejudice John only read-ASP

Our system contains everything we need to account for the behavior of *zhi*. First, we propose that *zhi* and *jiu* differ minimally in the semantics: *zhi* is ONLY$_{strong}$, while *jiu* is ONLY$_{weak}$. The two are repeated here as (57) and (58).

(57) $[\![\text{ONLY}_{strong}(\pi)]\!]$ is true iff $\forall q \in C[\pi \not\subseteq q \rightarrow \neg q]$
Alternatives not entailed by the prejacent are false.

(58) $[\![\text{ONLY}_{weak}(\pi)]\!]$ is true iff $\forall q \in C[q \subset \pi \rightarrow \neg q]$
Alternatives asymmetrically entailing the prejacent are false.

[19] This exemplifies Tancredi's (1990) Principle of Lexical Association (PLA): an operator like *only* must be associated with a lexical constituent in its c-command domain. Our discussion below constitutes a partial explanation of PLA. See Erlewine (2014) for a different view.

We also stick to varieties of alternatives. However, it turns out that although *jiu* (ONLY$_{weak}$) is sensitive to the atom/sum distinction of its alternatives, *zhi* (ONLY$_{strong}$) is not. A proposition involving an atomic individual, such as *that John read Emma*, is enough to make *zhi* exclusive (for the latter proposition is not entailed by the prejacent and thus negated by (57).).

Now the topicalization fact of *zhi* (56) follows from our assumption that topicalization gives rise to an anti-exhaustive presupposition. As is illustrated in (59), this anti-exhaustive presupposition contradicts *zhi*'s assertion, and we suggest this explains why *zhi* is unable to associate with a topic.

(59) *AOMANYUPIANJIAN$_{CT,1}$ Yuehan zhi kan-guo t_1.
Pride.and.Prejudice John only read-ASP
Assertion of *zhi*: John did not read other books.
Presupposition of CT: John might have read other books.

Our explanation of (56) could be extended to English. As is shown by (60), English *only* does not allow topicalization but *even* does.

(60) a. *Emma$_{CT1}$, John only read t_1.
b. Emma$_{CT1}$, John even read t_1.

We suggest that English *only* is strong (which happens to be the standard analysis of *only*). Together with the assumption that topicalized foci are CTs, it explains why English *only* does not allow topicalization of its associate but *even* does: because ONLY$_{strong}$ (but not *even*) triggers exclusivity (regardless of varieties of alternatives) and contradicts CT's anti-exhausitve requirement.[20]

Time to summarize. In this section, we have shown how the system sketched in Sect. 2 that uses varieties of alternatives to generate 'ambiguities' can be constrained and regulated. Specifically, not every FP is 'ambiguous', because the semantics of an FP might not be sensitive to the distinction that we posit for its alternative sets, for instance Mandarin *zhi* and possibly English *only*. Furthermore, even if an FP itself is 'ambiguous', a particular sentence containing the FP might not be. *Jiu* is such a case. We have explained this type of non-ambiguity of *jiu* by independent motivated proposals and principles such as contrastive topics and maximize presupposition.

In the next section we will address four issues that emerge when we consider the present proposal against earlier work on *jiu* and *dou*: *jiu* is not ambiguous, *dou* is not quantificational, *dou* is not just a maximizer and *dou* does not work well with *covers*.

[20] Our analysis of (60a)–(60b) is an alternative to Erlewine (2014), where the crucial difference between *only* and *even* is that *only* affects truth-conditions while *even* does not (it only adds presuppositions). Different from Erlewine, we emphasize the exclusive-nonexclusive distinction (an idea picked up from Krifka 1998, Sect. 3.6). Interestingly, exclusive particles like *only* seem to be the only focus particles that change truth-conditions. So our prediction and Erlewine's might not be that different. Overall, we remain neutral on whether Erlewine's proposal is correct. If it turns out that he is on the right track, all we have to change is the anti-exhaustiveness-based account of the non-ambiguity of nonexclusive *jiu* (Sect. 3.1); the rest of the proposal including varieties of alternatives and lexical entries of *jiu* and *dou* will stay intact. However, notice that Erlewine's proposal has nothing to say about anti-exhaustiveness; this would leave the anti-exhaustiveness of sentences containing non-exclusive *jiu* (for example (54)) unexplained, if we were to adopt his proposal.

4 Connection to previous work

4.1 No lexical ambiguities for *jiu*

As far as I am aware, our unified analysis of *jiu* is the first proposal that captures both its exclusive and non-exclusive 'uses'. All the other analyses (Biq 1984; Lai 1999; Hole 2004, p. 18, a.o.) explicitly or implicitly adopt a lexical-ambiguity view. Everything being equal, a unified analysis is to be preferred. In this subsection, we will further show that an ambiguity analysis of *jiu* (or any analysis that separates exclusivity from *jiu*) misses important correlations, and thus is to be dispreferred on empirical grounds as well.

First, *jiu*'s scalarity and the availability of its exclusivity are correlated.

To see the correlation, consider the scalar inferences *jiu* can trigger. Our previous examples have identified two such scalar inferences: an easy-to-obtain (2) inference and a small-in-number inference (1) (see Sect. 2.4.2).

As an example of the correlation, an easy-inference never combines with exclusivity, while a small-in-number inference usually does. For example, our exclusive-*jiu* example (61a) can never have the meaning in (61b), which is a combination of the easy-inference with an exclusive inference.

(61) a. Jiu YUEHAN hui shuo fayu.
JIU John can speak French
'Only John can speak French.'
b. **Not**: John is easy to get hold of, *easy-to-obtain*
and no people other than John can speak French. *exclusive*

Similarly, the non-exclusive-*jiu* example (62a) never has the meaning in (62b), which combines a small-in-number inference with a non-exclusive *jiu*.

(62) a. YUEHAN jiu hui shuo fayu.
John JIU can speak French
'John, who is easy to get hold of, can speak French.'
b. **Not**: Few people can speak French, *small-in-number*
and/but John can speak French. *non-exclusive*

This is expected under our proposal: computations of the scalar inference and the exclusive inference (or the lack of it) are closely connected, i.e., they rely on the same alternative set: in order to get an easy-inference, an atom-based alternative set $\{j < b < m\}$ that ranks different individuals has to be employed, which is only compatible with a nonexclusive interpretation of *jiu*; similarly, to get a small-in-number scalar inference in cases like (61a) or (62a), we need a sum-based alternative set $\{j < j \oplus b, j \oplus m < j \oplus b \oplus m\}$, which automatically generates an exclusive interpretation. In general, the correlation between scalarity and exclusivity naturally follows from our proposal.

The second correlation predicted by our proposal concerns the connection between exclusivity, distributivity and collectivity. Consider (63)–(64).

(63) Shangci, jiu liang$_F$-ge ren taiqi le gangqin.
last.time, JIU two-CL people lift ASP the.piano
'Only two people lifted the piano.'

(64) Shangci, liang$_{CT}$-ge ren jiu taiqi le gangqin.
Last.time two-CL people JIU lift ASP the.piano
'Last time, a group of two people, which was a small group, together lifted the piano.'

(63) means only two people (individually) lifted the piano, a distributive reading with an exclusive inference,[21] while (64) has without an exclusive inference only a collective reading that a group of two people, which was a small group, together lifted the piano.

This interesting pattern follows from our proposal. A distributive construal of the prejacent in (63) delivers the C_{sum} in (65) while a collective reading of the prejacent in (64) gives rise to the C_{atom} in (66). The former contains stronger propositions, thus exclusivity and the corresponding [*jiu* > Associate] form, while the latter does not contain stronger propositions, thus non-exclusivity and the corresponding [Associate > *jiu*] form (see (49) for the generalization).

(65) C_{sum} of (63)= { ~~that three people each lift the piano~~, that two people each lift the piano (= π), … }

(66) C_{atom} of (64)= { that three people together lift the piano, that two people together lift the piano (= π), … }

Again, the correlation between distributivity/collectivity and exclusivity is a natural consequence of our proposal: distributivity and collectivity lead to different types of alternative sets, to which *jiu* as ONLY$_{weak}$ is sensitive.

There is a caveat. Consider (67)–(68), where the numeral phrase *two people* in (63)–(64) is replaced by a conjunction of two proper names *John and Mary*.

(67) Shangci, jiu Yuehan he Mali taiqi le gangqin
Last.time, JIU John and Mary lift ASP the.piano
'Last time, only John and Mary lifted the piano.'

(68) Shangci, Yuehan he Mali jiu taiqi le gangqin
Last.time, John and Mary JIU lift ASP the.piano
A. 'Last time, John and Mary, which was a small group, lifted the piano.'
B. 'Last time, John and Mary, to give you two initial examples, lifted the piano.'

[21] (63) should be read with no pause between *liang-ge ren* 'two people' and *taiqi* 'lift'. With a pause, the sentence could have a bi-clausal structure [*e* JIU two.people] [*e* lifted.the.piano] with *e* standing for empty pronouns and the pause indicating the clause boundary. (63) under this LF can be paraphrased as 'they are only two people; they lifted the piano', with a collective reading.

An anonymous reviewer asks whether my proposal predicts (67) to have only a distributive+exclusive reading, and s/he remarks that it can also be read collective+exclusively. I share the judgment.

My proposal gets both readings. The distributive+exclusive reading is obtained by taking *John and Mary* to be a sum $j \oplus m$ and its alternatives other sums $\{j \oplus m, j \oplus m \oplus s \ldots\}$. The collective+exclusively reading is achieved by taking *John and Mary* to be a group $\uparrow (j \oplus m)$ and its alternatives other groups and their sums $\{\uparrow (j \oplus m), \uparrow (b \oplus s), \uparrow (j \oplus m) \oplus \uparrow (b \oplus s), \ldots\}$ (Landman 2000, Sect. 6.3). With a distributive operator that can distribute to non-pure atoms (groups), both of the resulting *C*'s contain strictly stronger propositions, thus the exclusivity. Finally, (63) (without pause, see footnote 21) does not have the collective+exclusive option since alternatives to the prejacent such as *three people lifted the piano* does not have a meaning equal to *that a group of two people lifted the piano and another person also lifted the piano* (though it could be true in such a context), which is needed to trigger exclusivity of *jiu* under a collective construal of the prejacent.

Another reviewer asks whether my proposal predicts (68) to have only a collective+non-exclusive reading, and s/he thinks it also has a distributive+non-exclusive construal, which corresponds to the B-reading in (68). My proposal also gets this reading, by putting *Dist* above *jiu* and associating *jiu* with a trace, similar to (32) where *dou* is associated with a trace and a distributive+*even* reading obtains. With an LF like [$j \oplus m$ [*Dist* [λ_1 JIU [$t_{1,F}$ lift.the.piano]]] and the trace activating atomic alternatives, exclusivity of *jiu* is not triggered and a scalar implication that both John and Mary are easy to get hold of—they quickly pop up in the speaker's mind—observed. Finally, our previous example (64) with a numeral again does not have this option, presumably because the indefiniteness of the numeral phrase *two people* is incompatible with the determinacy of situating each person of the two people on a scale. The following contrast in (69) supports the story.

(69) a. liang-ge ren jiu taiqi le gangqin.
two-CL people JIU lift ASP the.piano
'A group of two people, which was a small group, together lifted the piano.'

b. *liang-ge ren jiu hui shuo fayu.
two-CL people JIU can speak French
Intended: 'Two people can speak French.'

c. zhe liang-ge ren jiu hui shuo fayu.
these two-CL people JIU can speak French
'These two people, who are right in front of you, can speak French.'

First, as is claimed above, (69a) (repeated from (64)) only has a collective reading, and this is supported by (69b) where an inherently distributive predicate *can.speak.French* simply gives rise to ungrammaticality. Furthermore, replacing the indefinite in (69b) with a demonstrative phrase as in (69c) resumes grammaticality, supporting our claim that indefiniteness plays a role in causing the problem.

Overall, despite the two complications brought by summation over groups and association with traces, I claim based on the contrast between (63) and (64) that the correlation between distributivity/collectivity and exclusvity is real.

In sum, the two correlations discussed above are not captured by ambiguity-based analyses: suppose that *jiu* is ambiguous between jiu_{scalar} and $jiu_{exclusive}$; there is no reason why the former picks collective readings in (64) while the latter distributive ones in (63). Furthermore, any analysis of *jiu* that separates its exclusive component from its scalar component (as an ambiguity analysis would have to) cannot explain the close connection between the two.

4.2 *Dou* is not quantificational

Most analyses of *dou* treat *even*-less *dou* as a quantificational element, either a (adverbial) universal quantifier (Lee 1986; Cheng 1995; Dong 2009) or a distributive operator (Lin 1998; Yang 2001; Chen 2008). In this subsection, we will take the distributive operator analysis in Lin (1998) as the representative of the quantificational analyses (but what we will say applies to the universal quantifier analyses as well). We will argue that *dou* cannot be quantificational, because it does not have fixed quantificational force and it does not take scope.

There are mainly two types of facts that motivate Lin (1998) to treat *dou* as a distributive operator (whose semantics equals to the covert $Dist$ in (19)).

First, when associated with a plural definite, *even*-less *dou* forces distributive readings. This is *dou*'s distributive effect (16) discussed in Sect. 2.2.

The second type of facts involves quantifiers. Most importantly, universal quantification in Mandarin requires the presence of *dou*, illustrated in (70a).

(70) a. Mei-ge-xuesheng *(dou) mai-le yi-ben-shu.
every-CL-student DOU buy-ASP one-CL-book
'Every student bought a book.'

b. $[\![\text{mei-CL-student}_{\text{LIN}}]\!] = \bigoplus \mathsf{student}(x)$[22]

c. $\forall x[(x \leq \bigoplus \mathsf{student} \wedge Atom(x)) \rightarrow \exists y(\mathsf{book}(y) \wedge \mathsf{bought}(x, y))]$

Lin (1998) analyzes the *every-dou* puzzle as follows: different from English *every*-NP, Mandarin *meige*-NP is referential (70b), synonymous with *the*-NP. Thus it requires *dou* in order to express a quantificational meaning, as in (70c).

Notice however assigning *meige*-NP a (plural) definite semantics does not really explain why *meige*-NP needs *dou*: there is no reason why a plural definite $\oplus\mathsf{student}$ cannot directly combine with the VP predicate $\lambda x \exists y[P(x) \wedge \mathsf{book}(y) \wedge \mathsf{bought}(x, y)]$, delivering a collective reading in Lin's framework (where collectivity does not need groups). Lin seems to be aware of this problem. He appeals to syntax: *meige*-NP carries a Q-feature, and thus it has to be distributively quantificational and needs *dou*.

[22] $\bigoplus \mathsf{student}(x)$ is a (presupposition-less) notational variant of $\sigma x.\mathsf{student}(x)$ (Sharvy 1980; Link 1983), which stands for the mereological sum of all entities to which student applies. we adopt this notation from Champollion (2010). Notice that Lin's own analysis uses *sets* instead of *sums* to represent pluralities, so he has $\bigcup \mathsf{student}$. We systematically use *sums*.

This weakens Lin's overall semantic account. Later, we will present our take on this *every-dou* puzzle.

From the above illustration of Lin's account we can see that the essence of a distributive operator analysis (and other quantificational analyses) of *dou* is that *dou*, being quantificational, introduces universal quantification into the truth-conditional semantics. Below, we would like to challenge this basic idea, by showing that *dou* does not seem to be quantificational and *meige*-NP in Mandarin is not referential. Our evidences concern two very important aspects of a quantificational element—quantificational force and scope.

Consider first quantificational force. When *dou*'s associate is a definite, another quantificational element Q_{adv} can be added, with the resulting sentence carrying various quantificational force based on the Q_{adv}. This is the quantificational variability (QV) problem of *dou*.

(71) Tamen daduo/henduo dou xihuan Lisi.
they most/many DOU like Lisi
'Most/many of them like Lisi.' Definite → √-QV

(71) seems to be a problem for analyses that treat *dou* as a quantificational element. It shows that a *dou*-sentence doesn't uniformly have ∀-quantification.[23] In other words, if *dou* were indeed quantificational, it would have to be a very vacuous one.

Further and more importantly, *meige*-NPs '*every*-NP' do not show quantificational variability (72).

(72) meige xuesheng (∗daduo/∗henduo) dou xihuan Lisi.
every student most/many DOU like Lisi
Intended: 'Most/many of the students like Lisi.' *every*→ ∗-QV

A comparison of (71)–(72) suggests that Mandarin *every*-NPs are quantificational while definite NPs are not. Thus the latter but not the former allows for another quantificational element. But this distinction (betweem definites and *meige*-NP) is hard to maintain under Lin's quantificational analysis of *dou*.

Next let us turn to scopal facts. Under a quantificational analysis of *dou*, *dou* is expected to take scope. Since Mandarin is a famous surface-scope-only language (Huang 1982), we expect everything that comes before *dou* at the surface to have semantic scope over ∀ (introduced by *dou* according to a quantificational analysis), and everything after *dou* to fall within the scope of ∀. (73)–(74) seems to confirm this prediction (Yang 2001). In (73), *dou* comes before negation and the sentence has the

[23] I take the *daduo/henduo* in (71) to be adverbial (generalized) quantifiers relating two sets of atomic individuals, roughly $\lambda P \lambda X.\text{MOST/MANY}(\lambda x[x \leq X \wedge Atom(x)], P)$. They are not like English *most of the NPs* that introduces ∃-quantification over a group X whose cardinality is greater than a half of the NPs (Nakanishi and Romero 2004). The evidence for this analysis comes from the fact that adverbial *daduo/henduo* do not allow collective readings; that is, [they *daduo/henduo* lift the piano] can only be interpreted distributively, unlike *most of the NPs* but similar to *most NPs* (Nakanishi and Romero 2004, footnote 3). Under this analysis of *daduo/henduo*, it is hard to make sense of the *dou* in (71), if it is indeed a universal.

$\forall > \neg$ reading; in (74), negation comes before *dou* and the sentence is interpreted as $\neg > \forall$.

(73) Tamen dou bu xihuan Lisi.
they DOU not like Lisi
'They all don't like Lisi.' $\forall > \neg$

(74) Tamen bu-(shi) dou xihuan Lisi.
they not-(be) DOU like Lisi
'Not all of them like Lisi.' $\neg > \forall$

However, *meige*-NPs 'every-NP' are different again. In (75), both *meige* and *dou* occur before negation, and the sentence has $\forall > \neg$ reading, a result compatible with a quantificational analysis of *dou*. On the other hand, a $\neg > \forall$ reading surprisingly requires negation to appear before *meige*-NP at the surface (76); just putting negation before *dou* results in ungrammaticality (77).

(75) meige xuesheng dou bu xihuan Lisi.
every student DOU not like Lisi
'Every student is such that they don't like Lisi.' $\forall > \neg$

(76) bu-shi meige xuesheng dou xihuan Lisi.
not-be every student DOU like Lisi
'Not every student likes Lisi.' $\neg > \forall$

(77) *meige xuesheng bu-(shi) dou xihuan Lisi.
every student not-(be) DOU like Lisi
Intended: 'Not every student likes Lisi.' *every>NOT>DOU

(78) Tamen bu-(shi) dou xihuan Lisi.
they not-(be) DOU like Lisi
'Not all of them like Lisi.' they>NOT>DOU

The scopal contrast between *meige*-NPs (77) and definites (78) is again unexpected under Lin's quantificational analysis of *dou*, where *meige*-NPs and plural definites are treated on a par. Instead, the behaviors of *meige*-NPs in (76)–(77) suggest that *meige*-NP should really take scope, explaining why a $\neg > \forall$ reading must have negation appear before *meige*-NP (instead of just *dou*) at the surface. But if *meige*-NPs take scope, *dou* had better not.

We seem to have a dilemma: (73)–(74) suggests *dou* takes scope, while (76)–(77) shows the opposite.

Yet the dilemma is only superficial. First, even in the definite-case, *dou* need not take scope: an overt $Q_\forall$ *quan*, if present, determines scope. The contrast between (79) and (80) shows that (exactly as in the case of *meige*-NPs (76)–(77)), in order to get a $\neg > \forall$ reading, negation has to appear before *quan*, indicating *quan*, rather than *dou*, is the scope-taking universal.

(79) Tamen bu-shi **quan** dou xihuan Lisi.
they not-be all DOU like Lisi

'Not all of them like Lisi.' $\neg > \forall$

(80) ∗Tamen **quan** bu-(shi) dou xihuan Lisi.
they all not-(be) DOU like Lisi
Intended: 'Not all of them like Lisi.' ∗*quan* >NOT>DOU

In the absence of *quan*, we can rely on the covert distributive operator *Dist* (19) posited in Sect. 2.2 and require it to sit next to *dou* to capture *dou*'s 'scopal' facts. In other words, (73) and (74) actually have the following structures (81)–(82), and what takes scope in these structures is the *Dist*, not *dou*; since *dou* is next to *Dist*, other scopal elements that appear before or after *Dist* at LF also appear before or after *dou* at the surface, thus *dou*'s 'scopal' facts.[24]

(81) [*they* [*dou* [*Dist* [¬ *like Lisi*]]]]

(82) [*they* [¬ [*dou* [*Dist like Lisi*]]]]

It's time to take stock. We have shown that a quantificational analysis of *dou* such as Lin's (1998) is problematic. *Dou* neither has obvious quantificaitonal force nor determines scope. It simply does not behave like a quantificational expression. On the other hand, *meige*-NP '*every*-NP', although it generally requires *dou*'s support, is truly quantificational: it contributes stable quantificaitonal force (universal) and takes scope.

After showing the inadequacy of a quantificational analysis, we have to make sure that our proposal for *dou* can handle (or at least is compatible with) the facts discussed above. We know how our proposal accounts for the distributive effect of *dou* from Sect. 2.2, but we don't have an analysis of *meige*-NP and its association with *dou* yet, to which we now turn.

Based on the facts discussed above, we propose Mandarin *meige*-NP is quantificational with standard generalized quantifier semantics (Barwise and Cooper 1981). We also assume with von Fintel (1994) that quantifiers have covert domain restriction variables ranging over properties of indivduals and represent it as $_D$ in (83). Further, our *dou* is still *even* (84), repeated from (17).

(83) $[\![\text{mei}_D\text{-CL-student}]\!] = \lambda P \forall x \in [\![D]\!][\mathsf{student}(x) \rightarrow P(x)]$

(84) $[\![dou(\pi)]\!]$ is defined iff $\forall q \in C[\neg(\pi = q) \rightarrow \pi \prec_{likely} q]$
if defined, $[\![dou(\pi)]\!] = [\![\pi]\!]$

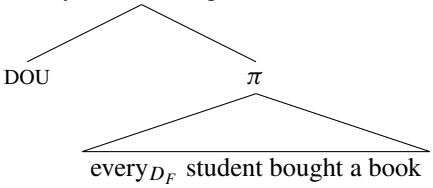
Next, *dou* associates with an alternative-triggering item, so we need to determine the alternatives to *meige*-NP, which we propose to be its subdomain alternatives (85) (Chierchia 2013).

[24] Some clarifications: under an account where *meige*-NP, *quan* and *Dist* are quantificational while *dou* is not, (77) and (80) are predicted to have a $\forall > \neg$ reading. Yet the two are bad; this is because, we suggest, the default position of (a narrow scope) negation is low (Beghelli and Stowell 1997), and there is no motivation to move it across *dou*. Indeed, in all cases of $\forall > \neg$, negation has to appear after *dou*, if *dou* is present. See (75) for an example.

(85) $\mathcal{A}lt([\![\text{mei}_D\text{-CL-student}]\!])$
$= \{\lambda P \forall x \in [\![D']\!][\textsf{student}(x) \rightarrow P(x)] : [\![D']\!] \subset [\![D]\!]\}$

Finally, we assume that a sentence contaning a *meige*-NP and *dou* such as (86a) has the analysis in (86b), with *dou* having sentential scope.

(86) a. Mei-ge-xuesheng dou mai-le yi-ben-shu.
every-CL-student DOU buy-ASP one-CL-book
'Every student bought a book.'

b.


c. $[\![\pi]\!] = \forall x \in [\![D]\!][\textsf{student}(x) \rightarrow \exists y(\textsf{book}(y) \wedge \textsf{bought}(x, y))]$

d. $\mathcal{A}lt([\![\pi]\!]) = \{\forall x \in [\![D']\!][\textsf{student}(x) \rightarrow \exists y(\textbf{book}(y) \wedge \textsf{bought}(x, y))] :$
$[\![D']\!] \subset [\![D]\!]\}$

With the LF in (86b), (86c) is the meaning of the prejacent π, and (86d) as π's alternatives.

Now we have a familiar situation: the prejacent entails all the other alternatives. Again, *dou*'s *even* presupposition is trivialized, and this is, I claim, why *dou* is possible with *meige*-NPs without contributing an *even* flavor.

To explain why *dou* is required, we suggest that the domain variable of *mei* 'every' is obligatorily focused; in other words, it always triggers subdomain alternatives, similar to NPIs in Chierchia (2013). Thus, it needs *dou* to exhaustify these alternatives away.

Now with *dou* being *even* and *meige*-NPs quantificational, our proposal are compatible with all the facts discussed in this subsection. Since *meige*-NPs are quantificational, they do not allow quantificational variability (72), and they determine the scope of the universal based on their surface positions (76). Since definites are non-quantificational, they allow quantificational variability (71) and the 'scopal facts' of *dou* (73)–(74) are due to a covert $Dist$ on VP that sits next to *dou*. Finally, since *dou* is *even* and truth-conditionally vacuous, it does not interfere with any of the above truth-conditional phenomena.[25]

4.3 *Dou* is not just a maximizer

We have seen that *even*-less *dou* still has the maximality effect (to satisfy the universal part of *even*). This aspect of *dou* has been emphasized in Xiang (2008) and Cheng (2009), who follow Giannakidou and Cheng (2006) analyzing *dou* as a maximality operator (87) (setting aside intensionality).

[25] We do need *dou* to scope over a universal to get its *even* meaning trivialized. This is easy to obtain even with negation around. To get a $\forall > \neg$ reading, *dou*$> \forall > \neg$ will do, while $\neg > \forall$ requires $\neg >$ *dou*$> \forall$, both of which can be achieved by covert movement of *dou*.

(87) $[\![dou_{G\&C}]\!] = \lambda P.\sigma x P(x)$

(88) (cf. Cheng 2009, p. 67) supports (87). In (88), the bare numeral phrase associated with *dou* is interpreted as a definite: (88) is felicitous only if there are exactly three students in the context. This definiteness effect of *dou* is straightforwardly captured by directly treating *dou* as a definite determiner (and *three* as having an adjectival semantics $\lambda P \lambda X.|X| = 3 \wedge P(X)$).

(88) san-ge xuesheng dou mai.le yi.ben shu.
three-CL student DOU buy.ASP one.CL book
'The three students each bought one book.'

However, we observe that (88) also shows the distributive effect. It only has a distributive reading that the three students each bought one book; it lacks the collective reading that the three students together bought one book. This is not captured by treating *dou* as a definite determiner/maximality operator.

Our proposal captures both *dou*'s maximality/definite effect and its distributive effect. Both of them are derived from its *even* presupposition. Let's illustrate this claim again by considering how (88) is analyzed in our system.

First, we propose that *three students* is an existential quantifier and activates scalar alternatives, as in (89a)–(89b).

(89) a. $[\![\text{three students}]\!] = \lambda P \exists X[\textsf{students}(X) \wedge |X| = 3 \wedge P(X)]$
b. $\mathcal{A}lt([\![\text{three students}]\!]) = \{\lambda P \exists X[\textsf{students}(X) \wedge |X| = n \wedge P(X)] : n \in \mathbb{N}^+\}$

(89) is compatible with both distributivity and collectivity. Consider distributive readings first. Combining *three students* with $Dist(\textit{bought a book})$, we get π and its alternatives in (90).

(90) a. $[\![\pi]\!] = \exists X[\textsf{students}(X) \wedge |X| = 3$
$\wedge \forall y\ (\ y \in X \wedge Atom(y) \rightarrow y\ \textsf{bought.a.book})]$
b. $\mathcal{A}lt([\![\pi]\!]) = \{\exists X[\textsf{students}(X) \wedge |X| = n$
$\wedge \forall y\ (\ y \in X \wedge Atom(y) \rightarrow y\ \textsf{bought.a.book})] : n \in \mathbb{N}^+\}$

Now consider contexts where there are exactly three students. In such contexts, any alternative with $n > 3$ won't be included in the actual alternative set C. This is because it does not make sense to consider a proposition like *there are four students such that each of them bought a book* if we already know there could only be three students. Thus, the C has to be the one in (91).

(91) $C_{=3} = \left\{ \begin{array}{l} \text{there are 3 students such that each bought a book } (= \pi), \\ \text{there are 2 students such that each bought a book,} \\ \text{there are 1 students such that each bought a book,} \end{array} \right\}$

This is again familiar: *dou*'s prejacent entails all the other alternatives. Thus the *even* presupposition of *dou* is satisfied and the *even* flavor is trivialized.

Things change when there are more than three students in the context. Suppose there are four (92). In this case, there is a proposition q in C entailing the prejacent;

dou's presupposition then cannot be satisfied (again, if p entails q, q cannot be more unlikely than p) and the sentence is thus infelicitous in the context.

(92) $$C_{>3} = \left\{ \begin{array}{l} \text{there are 4 students such that each bought a book } (= q), \\ \text{there are 3 students such that each bought a book } (= \pi), \\ \text{there are 2 students such that each bought a book,} \\ \text{there are 1 students such that each bought a book,} \end{array} \right\}$$

In other words, to get an *even*-less *dou* in (88), the context has to contain exactly 3 students.[26] In this way, we have derived the definiteness effect (and the distributive effect) of *dou* in (88) from its *even* presupposition.

Finally, we turn to collective interpretations. With a collective reading of (88), the prejacent and its alternative propositions do not stand in an entailment relation; thus *dou*'s *even* presupposition cannot be trivialized. Then we predict the sentence can only be used in a context where the prejacent is the most unlikely one within C. It turns out that it is very difficult to find a context where it is unlikely that a group of three students together bought a book, and that's why the most salient reading of (88) is the distributive + definite one.[27]

On the other hand, if we increase the number of books, the resulting sentence begins to have the collective + *even* reading (93).

(93) san-ge xuesheng dou mai.le shi.ben shu.
three-CL student DOU buy.ASP ten.CL book
'The three students each bought 10 books.'
Or 'A group of three students bought 10 books, which is unlikely.'

(93) has a distributive + definite *even*-less reading and a collective + *even* reading; both are predicted by our proposal. The former involves alternatives based on sums while the latter alternatives based on groups/atoms.

To summarize, *even*-less *dou* shows both the distributive effect and the maximality effect. Lin's (1998) distributive operator analysis captures the former but not the latter, while Giannakidou and Cheng's (2006) maximality operator analysis only captures the latter. Our proposal captures both of the effects, by deriving them from *dou*'s *even* presupposition.

4.4 Groups vs. covers

Our analysis of *dou* shares many of the same assumptions as Liao (2011), where she claims (following Mok and Rose 1997) that there is only one *dou* which has 'even' as its semantics, and that the distributive effect of *dou* is a trivialization of its

[26] What happens when there are less than 3 students in the context? In such a context, C won't contain the prejacent, which is ruled out by the Focus Interpretation Principle in Rooth (1992) which requires the prejacent to be always in C.

[27] There also seems to be a competition-blocking effect between *dou* and another FP *cai* (which we are not sure about how to gloss). To express the meaning that as many as three students only bought one book, which is unlikely, we would use [three students *cai* buy *le* one book].

'even' meaning. However, our implementation is very different from hers. Liao uses the notion of *cover* to analyze the distributive/collective distinction (Schwarzschild 1996), while the present analysis adopts the Link–Landman approach, with $\uparrow$. This turns out to have non-trivial empirical consequences.

Let's first see how a *cover*-based analysis of distributivity/collectivity works. In Schwarzschild's theory, a generalized distributive operator Dis_{COV} (94) always appears between a plural NP and its VP, and choices of covers determine whether we get a distributive or a collective reading.

(94) $[\![Dis_{COV}]\!] = \lambda P_{et} \lambda X_e . \forall y \in COV \wedge y \leq X \rightarrow P(y)$

In our setting using sums, a cover (COV) of a sum X is a set of parts of X whose sum is X (in other words, a cover is a partition of a sum that allows overlapping). For example, both $\{a, b, c\}$ and $\{a \oplus b \oplus c\}$ are COVs of $a \oplus b \oplus c$; the former gives rise to distributive readings, while the latter collective ones.

Further, Schwarzschild takes the COV in (94) to be a free variable (of type $\langle e, t \rangle$) determined by context.[28] Essentially, this allows contexts to modify the quantificational domain of the $\forall$ introduced by Dis_{COV}.

Let's look at a concrete example (95).

(95) a. John and Mary lifted the piano.
b. Dis_{COV}(lifted the piano)$(j \oplus m)$
c. $\forall y[(y \in g(COV_1) \wedge y \leq j \oplus m) \rightarrow \textsf{lifted the piano}(y)]$

(95a) is ambiguous (or vague according to Schwarzschild) between a distributive reading and a collective one. In Schwarzschild's theory, both of the readings have the LF in (95b) and the truth-condition in (95c); the meaning difference is captured by assigning different values to COV_1. With $g(COV_1) = \{j, m, \ldots\}$, we get the distributive reading, while with $g(COV_1) = \{j \oplus m, \ldots\}$ (without j or m in the set), we get the collective reading.

There is a crucial difference between a cover-based analysis and an analysis using groups. In the former, the distinction between collectivity and distributivity is captured entirely within VPs, while in the latter, both NPs (to which $\uparrow$ applies) and VPs (to which the distributive operator applies) are responsible for the distinction. Below, we suggest that theories (such as Dis_{COV}) where the distributive/collective distinction is only encoded in VPs cannot easily handle certain collective-among-alternatives situations. Consider (96).[29]

(96) a. Even/*dou* [Jil, Mary and Sue]$_F$ can't lift the piano.
b. EVEN[*can't lift the piano*$(\uparrow j \oplus m \oplus s)_{\mathrm{F}}$]
c. EVEN[Dis_{COV_1}(*can't lift the.piano*)$(j \oplus m \oplus s_{\mathrm{F}})$]

[28] Following Schwarzschild (1996, p. 72), we take COV to cover the whole domain (instead of the plurality the VP is predicated of). COV has a role similar to domain restriction: they both restrict the quantification domain of a quantifier in certain ways.

[29] (96a) stands in for both the English sentence and its Mandarin counterpart using *dou*; we also move *dou* to the top to make it parallel to English *even*.

(96a) has a collective reading where we compare the likelihood of π: *j, m and s together can't lift the piano* with that of its alternatives such as ψ: *j and m together can't lift the piano*.

The present theory (96b) captures this by allowing $\uparrow\ j \oplus m$ to be an alternative of $\uparrow\ j \oplus m \oplus s$, thus capturing the collectivity of ψ and the collectivity of π at the same time. But a Dis_{COV} analysis cannot get the two collectivities. Crucially, since Dis_{COV} does not receive focus , the COV variable cannot vary among the alternatives of $j \oplus m \oplus s$. Yet a single COV_1 doesn't work: the collectivity of π requires $g(COV_1) = \{j \oplus m \oplus s\}$ (assuming that j, m, s are the only individuals in the context to simplify discussion), while the collectivity of ψ requires $g(COV_1) = \{j \oplus m, \ldots\}$. Since the two requirements cannot both be satisfied, a Dis_{COV} analysis (including Liao's analysis of *dou*) is unable to capture this collective reading of (96a).

Intuitively, the problem of Dis_{COV} is that the $_{COV}$ variable is within the VP, thus does not receive focus and cannot vary. This contrasts with $\uparrow$, which applies to the NP, thus receives focus and can vary across alternatives.

On the basis of the above we claim that Liao's unified account of *dou* does not have the same empirical overage as ours.

5 Conclusion

This paper has developed and motivated a particular view on how to analyze 'ambiguities' of focus sensitive operators. Versatility of a focus particle is analyzed as the possibility of associating the FP with varieties of alternatives. Two particular varieties have been identified: sum-based alternatives and atom-based ones. Together with novel analyses of Mandarin *jiu* as ONLY_{weak} and *dou* as EVEN, the limited theoretical options derive a large array of facts.

The paper also draws attention to the integration of plurality theory into alternative semantics. While the relevance of the atom/sum distinction to alternative sensitive operators has been observed by Dayal (1996) and motivates her answerhood operator, it is still not a common practice to think about pluralities in the context of focus particles. The paper demonstrates how Link-Landman's theory of pluralities is combined with Rooth's theory of focus association, explaining relevance of focus particles to distributivity/collectivity in Mandarin.

Finally, facts of focus association might also help us decide between theories of pluralities. In Sect. 4.4, we have given a preliminary case from focus association that favors groups over covers. More research is definitely needed to decide between the two theoretical options.

Acknowledgements The paper is built on my dissertation written at Rutgers. I am especially indebted to my adviser Veneeta Dayal for her help, support and patience. I am also grateful to the following people for valuable discussions and comments: Gennaro Chierchia, Simon Charlow, Mark Baker, Maria Bittner, Roger Schwarzschild, Kristen Syrett, Ken Safir, Jane Grimshaw, Lucas Champollion, Haoze Li, Jess Law, Yimei Xiang and Sha Zhu. Finally, thanks to the managing editor for this paper Daniel Büring and its anonymous reviewers for very helpful discussions and suggestions.

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