

Mandarin *dou*: The common core of distributivity, maximality, and EVEN¹

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Abstract. The paper presents a unified analysis of Mandarin *dou* as an alternative-sensitive (sentential) operator whose semantics equals to Karttunen and Peters (1979)'s EVEN. Different 'uses' of *dou* are analyzed by associating *dou* with different types of alternative sets: *even-dou* involves non-entailment-based alternative sets, while distributive-*dou* entailment-based ones.

Keywords: distributivity, maximality, *even*, Mandarin *dou*.

1. Introduction

Mandarin *dou* is well discussed in the literature (Lee 1986; Cheng 1995; Shyu 1995; Huang 1996; Lin 1998; Hole 2004; Chen 2008; Xiang 2008; Cheng 2009; Dong 2009; Liao 2011; Xiang 2016, a.o.). This very short paper will not examine every claim previously made concerning *dou*. Instead, it starts from a simple *dou* sentence as in (1) and checks it against two influential accounts of *dou*. It then shows that neither treating *dou* as a distributivity operator (Lin 1998; Chen 2008) nor taking it to be a maximality operator (Giannakidou and Cheng 2006; Xiang 2008) captures all aspects of (1). It then proposes that *dou* is an alternative-sensitive operator (cf. Liao 2011; Xiang 2016); specifically, it is EVEN. Different interpretations of a *dou* sentence are explained by associating *dou* with alternative sets of different properties: EVEN-*dou* corresponds to a (propositional) alternative set whose members stand in a likelihood relation, while DISTRIBUTIVE-*dou* corresponds to an alternative set based on entailment.

- (1) San.ge xuesheng dou mai.le shi.ben shu.
three-CL student DOU buy.ASP ten.CL book
a. EVEN-*dou*: 'A group of three students together bought 10 books, which is unlikely.'
b. DISTRIBUTIVE-*dou*: 'The three students each bought 10 books.'

Let me introduce the basic facts of *dou* exhibited in (1). (1) is ambiguous between (1a) and (1b) (with stress disambiguating the two).² Under (1a), *dou* adds an *even*-flavor and the sentence is interpreted collectively (the collective-cumulative distinction is irrelevant to our discussion), while in (1b) *dou* is *even*-less but triggers a distributive effect (Lin 1998) and a maximality effect (see especially Cheng, 2009: 67), indicated by the *each* and *the* in the gloss respectively.

2. Two previous accounts

2.1. *Dou* as a distributivity operator

Lin (1998) takes *dou* to be Link (1987)'s distributivity operator, as in (2). Being a predicate

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²Specifically, putting stress on *san* 'three' facilitates (1a) while stressing *dou* renders (1b). The paper will leave to another occasion an explanation of this fact at the semantics-prosody interface.

modifier, *dou* turns a mixed predicate such as *bought ten books* into a strictly distributive one, *each bought ten books* in this case.

$$(2) \quad \llbracket dou_{Lin} \rrbracket = \lambda P \lambda X \forall y [y \leq X \wedge Atom(y) \rightarrow P(y)]$$

While (2) straightforwardly explains the *each* in (1b), it fails to capture *dou*'s maximality/definiteness effect in the same environment — the *the* in (1b). Importantly, bare numerals such as *san.ge xuesheng* 'three students' in other contexts are not interpreted as definites in Mandarin. This is already evidenced by (1a) which can be felicitously (and truthfully) uttered in a context where there were more than three students in the context but only three bought books, and the three book-buyers together bought ten books.

2.2. *Dou* as a maximality operator

The maximality aspect of *dou* has been emphasized in Xiang (2008) and Cheng (2009), who follow Giannakidou and Cheng (2006) analyzing *dou* as a maximality operator as in (3).

$$(3) \quad \llbracket dou_{G\&C} \rrbracket = \lambda P. \sigma x P(x)^3$$

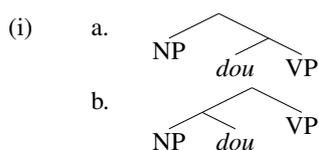
(3) is essentially what Sharvy (1980) and Link (1983) posit for the meaning of the definite article in English. It thus directly captures the maximality/definiteness effect of *dou* in (1b) (with *three* treated as having an adjectival semantics $\lambda P \lambda X. |X| = 3 \wedge P(X)$).⁴

However, remember that (1b) also shows the distributive effect. It only has the distributive reading that the three students each bought ten books; it lacks the collective reading that the three students together bought ten books. This is not captured by treating *dou* as a definite determiner/maximality operator.

In sum, neither the distributivity operator analysis nor the maximality operator analysis captures the behavior of *dou* in (1b). Additionally, neither of the two offers a ready explanation of *dou*'s *even*-flavor in (1a).

³Giannakidou and Cheng (2006) and Cheng (2009) use t , while following Link (1983) I use σ . I also ignore intensionality. Finally, Giannakidou and Cheng do not specify the semantics of σ explicitly. I adopt the standard treatment: $\sigma x.P(x)$ is defined if $\bigoplus P \in P$, and if defined $\sigma x.P(x) = \bigoplus P$, following Sharvy (1980).

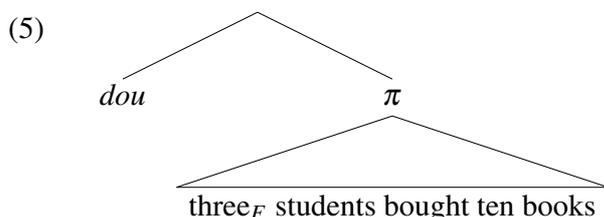
⁴We also need to tamper with the syntax. Instead of having the structure in (ia), which is required by a distributivity operator analysis of *dou* and agrees with *dou*'s adverbial status, we need (ib) to make (3) work (see especially Giannakidou and Cheng 2006: (78)).



3. *Dou* as EVEN

We present a unified analysis of Mandarin *dou* that captures not only its distributive and maximality effects in (1b), but also its *even*-flavor in (1a). The central idea is that *dou* is just EVEN, with the semantics of English *even* proposed in Karttunen and Peters (1979) (cf. Liao 2011: 217). In (4), π stands for the prejacent of *dou*, and $\llbracket \pi \rrbracket^{Alt}$ its alternative semantic value (Rooth, 1985, 1992), a set of propositions in this case. Notice that I assume for simplicity that *dou* takes sentential scope, which could be achieved either by movement of *dou*, similar to movement of *even* (Wilkinson 1996, Karttunen and Peters 1979, Lahiri 1998, Crnič 2014), or by making *dou* an indicator of a covert *even* that has sentential scope (Liao, 2011: 215). In the latter view, *dou* does not have its own meaning. The paper adopts the movement view as in (5), but nothing crucial hinges on this. Finally, I take it that in (1), *three* is the alternative trigger (evidenced by the prosodic profile of (1a), see footnote 2), and I use $_F$ to mark it.

- (4) $\llbracket dou(\pi) \rrbracket$ is defined
 iff $\forall q \in \llbracket \pi \rrbracket^{Alt} [\neg(\llbracket \pi \rrbracket = q) \rightarrow \llbracket \pi \rrbracket \prec_{likely} q]$
 if defined, $\llbracket dou(\pi) \rrbracket = \llbracket \pi \rrbracket$ (Karttunen and Peters, 1979)
 In words: *dou* is truth conditionally vacuous but presupposes that its prejacent is the most unlikely proposition among its alternatives (we set aside the additive presupposition of *even*).



Treating *dou* as EVEN naturally accounts for its *even*-flavor in (1a). (6) below is the alternative set I propose for (1a) (with *san.ge xuesheng* ‘three students’ interpreted as standard existentials, hinted by the *there were ...* in (6)). The prejacent indeed seems to be the most unlikely one among its alternatives.

- (6) $\llbracket \pi_{(1a)} \rrbracket^{Alt} = \left\{ \begin{array}{l} \dots \\ \text{three were 5 students such that they together bought 10 books,} \\ \text{there were 4 students such that they together bought 10 books,} \\ \text{there were 3 students such that they together bought 10 books (= } \pi \text{)} \end{array} \right\}$

Two questions arise at this point. First, why is the proposition *that there were 2 students such that they together bought 10 books*, which presumably is more unlikely than the prejacent, not in (6)? I think the answer has to do with contextual pruning. The same process would explain the felicity of *she even made it to the semi-finals_F*, even though *that she made it to the finals* is more unlikely (Kay, 1990).

A second question involves the obligatory collective reading of (1a). Why is the distributive reading not allowed with *dou*'s *even*-flavor? The next subsection is devoted to answering this question.

3.1. *Even*-less *dou*'s distributive effect

Let me first clarify my assumption about distributive readings. I analyze distributive readings by a covert distributivity operator (7) optionally on VP (Link, 1987).

$$(7) \quad \llbracket Dist \rrbracket = \lambda P \lambda x \forall y [(y \leq x \wedge Atom(y)) \rightarrow P(y)]$$

The existence of a covert distributivity operator in Mandarin Chinese is independently justified by (8a), 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: 229), but differs from Lin (1998: 201), who claims that (definite) plurals in Mandarin do not have distributive readings, unless *dou*, according to Lin a distributivity operator, is added. However, it seems that Lin did not take context into consideration. For (8a), even Lin himself (personal communication) agrees that a distributive reading is the preferred one. Below, (8b) and (8c) spell out the LF and semantics of (8a).

- (8) 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. $\llbracket_{TP} \text{Zhangsan and Lisi } \llbracket_{VP} Dist \llbracket_{VP} \text{drew two pictures} \rrbracket \rrbracket$
- c. $\forall y [(y \leq z \oplus 1 \wedge Atom(y)) \rightarrow \exists X [|X| = 2 \wedge pics(X) \wedge draw(y, X)]]$

With *Dist*, the prejacent of *dou* in (1)/(5) can be interpreted distributively. Specifically, I propose that (9) is the alternative set associated with *dou* in (1b), with *each* representing the distributivity operator *Dist*.

$$(9) \quad \llbracket \pi_{(1b)} \rrbracket^{Alt} = \left\{ \begin{array}{l} \text{there were 3 students such that each bought 10 books } (= \pi), \\ \text{there were 2 students such that each bought 10 books,} \\ \text{there were 1 students such that each bought 10 books,} \end{array} \right\}$$

Note that the propositions in $\llbracket \pi_{(1b)} \rrbracket^{Alt}$ 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). Thus, the *EVEN*-presupposition of *dou*, which essentially is a requirement on the shape of its alternative set, is weaker than what we

already know about the $\llbracket \pi_{(1b)} \rrbracket^{Alt}$ and is automatically satisfied.⁵ In this case, the *even*-flavor is trivial (cf. Liao 2011).

In other words, when the alternatives all stand in an entailment relation with the prejacent of *dou*, *dou*'s *even* presupposition can be trivialized.⁶ Crucially, since the entailment is made possible by the distributive operator (the *each* in (9)), the correlation between *even*-less *dou* and distributive readings is observed. This, I claim, is how *dou*'s *even* meaning could disappear in a distributive context in (1b), and the distributive effect of *even*-less *dou* is explained.

This also explains why (1a) is obligatorily collective. Only by being collective can the alternatives avoid standing in an entailment relation with the prejacent (*that 3 students together bought 10 books* has nothing to do with *that 4 students together bought 10 books*), and consequently likelihood and the *even*-flavor could surface.

3.2. *Even*-less *dou*'s maximality effect

The maximality/definiteness effect of *dou* also follows from our proposal. To illustrate, consider contexts where there are exactly three students. In such contexts, any alternative of the form *there were n students such that each bought 10 books* with $n > 3$ won't be included in the actual alternative set. This is because it does not make sense to consider a proposition like *that there were 4 students such that each bought 10 books* if we already know there could only be three students. Thus, the alternative set has to be the one in (9) and we have already seen how *dou* is licensed there without triggering an *even*-flavor.

Things change when there were more than three students in the context. Suppose there were four as in (10). In this case, there is a proposition *q* in the alternative set 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.

⁵We also need to assume that non-equivalent propositions within $\llbracket \pi_{(1b)} \rrbracket^{Alt}$ have different likelihood, which I take to be satisfied by normal contexts.

⁶A few more words on *dou*'s *even*-flavor and its disappearance in distributive contexts. When I said *dou*'s *even*-flavor is trivialized, I meant its (un)likelihood-flavor is indiscernible — that is, we do not feel any relation based on (un)likelihood between *dou*'s prejacent and its alternatives, and this is, I argued, due to the existence of a stronger entailment relation among the alternatives, because of distributivity. Some readers may find this intuitively hard to digest, but I believe the reason has to do with our choice of using comparative likelihood as the scale the semantics of *even* (and thus of *dou*) is based on (Karttunen and Peters, 1979). Several authors however argue that the scale of *even* should really be based on “pragmatic entailment”, “better informativeness” (Kay, 1990), “noteworthiness” (Herburger, 2000), or simply a contextually determined scale (Greenberg, 2016). With these theories, the disappearance of likelihood of *dou* in entailment contexts is more transparent: when entailment is available, *dou*'s prejacent can be the most noteworthy/informative by logically entailing all the other alternatives; only when entailment is unavailable is likelihood needed to make sense of noteworthiness/better informativeness. I take the above reasoning to be a variant of the idea presented in the main text, but I will stick to the proposal made above, trading popularity (of Karttunen and Peters (1979)'s semantics) for transparency.

$$(10) \quad \llbracket \pi_{n>3} \rrbracket^{Alt} = \left\{ \begin{array}{l} \text{there were 4 students such that each bought 10 books (= } q), \\ \text{there were 3 students such that each bought 10 books (= } \pi), \\ \text{there were 2 students such that each bought 10 books,} \\ \text{there were 1 students such that each bought 10 books,} \end{array} \right\}$$

In other words, to get the *even-less dou* in (1b), the context has to contain exactly 3 students.⁷ In this way, we have derived the maximality/definiteness effect of *dou* in (1b) from its *even* presupposition.

4. Concluding remarks

By examining a single *dou* sentence, the paper has sketched an analysis of Mandarin *dou* that captures its *even*-flavor, its distributive effect, its maximality effect, and the interaction among the three. For a detailed exposition of the analysis, its theoretical implications to the theory of pluralities and the theory of alternatives, and a comparison of the analysis with its close relative Liao (2011), the interested reader is referred to Liu (2017).

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⁷What happens when there were less than 3 students in the context? In such a context, the alternative set 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 the alternative set.

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