Mandarin *dou*: The common core of distributivity, maximality, and EVEN\(^1\)
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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

\(^1\)This paper reports some of the results of Liu (2017). I thank the persons acknowledged there, as well as reviewers and participants (Brian Buccola, Martina Faller, Yael Greenberg, Bernard Schwarz, Eytan Zweig) at SuB 21 for helpful discussion and comments. All errors are my own.

\(^2\)Specifically, 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.

\[(dou_{Lin}) = \lambda P \lambda X \forall y[y \leq X \land \text{Atom}(y) \rightarrow P(y)]\]

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.je 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).

\[(dou_{G&C}) = \lambda P.\sigma x P(x)^3\]

(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 \(\lambda P \lambda X. |X| = 3 \land P(X)\)).

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).

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3Giannakidou and Cheng (2006) and Cheng (2009) use \(i\), while following Link (1983) I use \(\sigma\). I also ignore intensionality. Finally, Giannakidou and Cheng do not specify the semantics of \(\sigma\) explicitly. I adopt the standard treatment: \(\sigma x P(x)\) is defined if \(\oplus P \in P\), and if defined \(\sigma x P(x) = \oplus P\), 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), $\pi$ stands for the prejacent of *dou*, and $[\pi]^{\text{Alt}}$ 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) \[ [dou(\pi)] \text{ is defined} \]
if $\forall q \in [\pi]^{\text{Alt}} \neg ([\pi] = q)$ \[ \rightarrow [\pi] \sim \text{likely } q \]
if defined, $[dou(\pi)] = [\pi]$ (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*).

(5)

\[ \frac{\text{dou}}{\pi} \]
\[ \text{three}_F \text{ students bought ten books} \]

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) \[ [\pi(1a)]^{\text{Alt}} = \left\{ \begin{array}{l} \ldots \\
\text{three were 5 students such that they together bought 10 books,}
\text{there were 4 students such that they together bought 10 books,}
\text{there were 3 students such that they together bought 10 books (} = \pi) \end{array} \right\} \]

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).

\[(7) \quad \text{\mbox{\footnotesize Dist}} = \lambda P \lambda x \forall y \{ y \leq x \wedge \text{Atom}(y) \rightarrow P(y) \}\]

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).

\[(8) \quad \begin{align*}
\text{a. (Context: I asked who among the kids drew two pictures; you replied:) Zhangsan & he Lisi hua le liang fu.} \\
& \text{Zhangsan and Lisi draw ASP two CL} \\
& \text{‘Zhangsan and Lisi each drew two pictures.’}
\end{align*}
\]

\[\text{b. } [\text{TP Zhangsan and Lisi } [\text{VP Dist } [\text{VP drew two pictures }]]] \]

\[\text{c. } \forall y \{(y \leq z \oplus 1 \wedge \text{Atom}(y)) \rightarrow \exists X \{ |X| = 2 \wedge \text{pics}(X) \wedge \text{draw}(y,X) \}] \]

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*.

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

Note that the propositions in $\left[ \pi_{(1b)} \right]^\text{Alt}$ stand in a very interesting relation: *dou*’s prejacent $\pi$ logically (asymmetrically) entails all the other alternatives.

We have proposed that *dou* is *EVEN*, whose semantics requires that the prejacent $\pi$ be less likely than all $\pi$’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 $[\pi_{(1b)}]^{Alt}$ and is automatically satisfied.\textsuperscript{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.\textsuperscript{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.

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

\textsuperscript{6}A 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) \[ [p_{n>3}]^{Alt} = \begin{cases} 
\text{there were 4 students such that each bought 10 books (}= q), \\
\text{there were 3 students such that each bought 10 books (}= \pi), \\
\text{there were 2 students such that each bought 10 books,} \\
\text{there were 1 students such that each bought 10 books,} 
\end{cases} \]

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).

References


\(^7\)What 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.
57–123.