Mandarin particle *dou*: A pre-exhaustification exhaustifier

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1. Introduction

- This paper presents a uniform semantics to capture the seemingly diverse functions of the Mandarin particle *dou*: quantifier-distributor, free choice item (FCI)-licenser, scalar marker, ...

1. Quantifier/distributor:

In a basic declarative, *dou* universally quantifies over the subparts of the denotation of the associated item (enclosed in “[●]”).

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

Under this use, *dou* brings up more semantic consequences than ∀-quantification. Descriptively:

“Distributivity Requirement”: if the prejacent sentence admits both collective and (atomic/non-atomic) distributive readings, applying *dou* eliminates the collective reading (Lin 1996).

(2) [Yuehan he Mali] **dou** jiehun -le.
    John and Mary **DOU** get-married -ASP
    ‘John and Mary each got married.’

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

“Plurality Requirement”: the item associated with *dou*, overt or covert, must be non-singular.

(4) Yuehan [(mei-ci)] **dou** qu Beijing.
    John every-time **DOU** go Beijing
    ‘For all the times, the place that John went to was Beijing.’

2. Scalar marker:

A [lia...dou...] construction evokes an even-like inference: the prejacent proposition is less likely than (some of) its alternatives. The use of *lian* is optional, but the associated item must be stressed.

(5) (Lian) [LINGDAO]¥ **dou** chi dao -le.
    even leader **DOU** late arrive -ASP
    ‘Even the leader was late.’ ～ The leader is less likely to be late.

When associated with a scalar item (usually stressed), *dou* implies that the prejacent sentence ranks relatively high w.r.t the contextually relevant measurement.

(6) **Dou** [WU dian]¥ -le.
    **DOU** five o’clock -ASP.
    ‘It is **dou** five o’clock.’ ～ It’s too late.

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3. FCI-licenser:

When associated with a pre-verbal *wh*-item/disjunction, *dou* evokes a $\forall$-FC reading.

(7) [Shei] *(dou) hejiu.
    \begin{align*}
    \text{Who}_{\text{FCI}} & \quad \text{dou} \quad \text{drink} \\
    \end{align*}

‘Anyone/everyone drinks.’

(8) [Yuehan huozhe Mali] *dou keyi jiao jichu hanyu.
    \begin{align*}
    \text{John} \quad \text{or} \quad \text{Mary} & \quad \text{dou} \quad \text{can} \quad \text{teach} \quad \text{Intro} \quad \text{Chinese} \\
    \end{align*}

Intended: ‘Both John and Mary can teach Intro Chinese.’

The licensing of the $\forall$-FCI use of a pre-verbal disjunction is subject to Modal Obviation: it is only licensed in a pre-*dou*+\$ position.

(8′) [Yuehan huozhe Mali] *dou*(keyi)*/bixu jiao jichu hanyu.
    \begin{align*}
    \text{John} \quad \text{or} \quad \text{Mary} & \quad \text{dou} \quad \text{can/must} \quad \text{teach} \quad \text{intro} \quad \text{Chinese} \\
    \end{align*}

Intended: ‘Both John and Mary can teach Intro Chinese.’

• Disambiguation by focus: If a sentence has multiple items that are eligible to be associated with *dou*, the function of *dou* and the association relation can be disambiguated by stress.

    \begin{align*}
    \text{they} & \quad \text{DOU/DOU} \quad \text{come} \quad \text{-EXP two-time} \quad \text{-ASP} \\
    \end{align*}

‘They ALL have been here twice.’

b. Tamen *dou* lai -guo [LIANG_{F-ci}] -le.
    \begin{align*}
    \text{they} & \quad \text{DOU} \quad \text{come} \quad \text{-EXP two-time} \quad \text{-ASP} \\
    \end{align*}

‘They’ve been here twice.’ $\rightsquigarrow$ They’ve been here many times.

c. (Lian) [TAMEN]_{F} *dou* lai -guo liang-ci -le.
    \begin{align*}
    \text{LIAN} & \quad \text{they} \quad \text{DOU} \quad \text{come} \quad \text{-EXP two-time} \quad \text{-ASP} \\
    \end{align*}

‘Even THEY have been here twice.’

• Overview

I propose that *dou* is a special exhaustivity operator, which (i) operates on pre-exhaustified sub-alternatives, and (ii) presupposes the existence of a sub-alternative. Descriptively:

10. \[
    [\text{dou}(S_{A})] \approx S_{A} \text{ and not only } S_{A’} \quad \text{(A’ is a subpart/ weak scale-mate/ sub domain-alt/ ... of A, ...)}
    \]

E.g. "[A and B] *dou* came" means: A and B came, not only A came, and not only B came.

"*dou* [it is five o’clock]" means: It’s 5 o’clock, not just 4 o’clock, not just 3 o’clock, ....

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2. Previous approaches

2.1. The distributor analysis (Lin 1998)

- *Dou* is a generalized distributor *Part* (Schwarzschild 1996). It distributes over the contextually determined cover of the associated item.

\[
\text{J}_{\text{dou}}(K) = 1 \iff \text{Part}_C(P, X) = 1 \iff \forall y [C(y) \land y \leq X \rightarrow P(y)], \text{where } C \text{ is a cover of } X.
\]

(11) \[ C \text{ is a cover of } X \text{ iff (i) } C \text{ is a set of subparts of } X; \text{ and (ii) every subpart of } X \text{ is a subpart of some member in } C. \]

For example: (3) "abc *dou* bought houses."

The possible covers of *abc* are:

- \{a, b, c\} Atomic distributive ‘*abc* each bought houses’
- \{a ⊕ b, c\}
- \{a ⊕ b, b ⊕ c\} Non-atomic distributive
- \{a ⊕ b ⊕ c\} Collective ‘*abc* together bought houses’

- Problems:
     (3) *abc dou* bought houses.
     (# w: *abc* all only participated in a single house-buying event.)
  2. Unlike English distributors like *each* and *all*, *dou* can be associated with a distributive expression like NP-*gezi* ‘NP each’.
     (13) They each (*each/*all) has some advantages.
     (14) [Tamen] *gezi dou you* yixie youdian.
         They each *dou* have some advantage
          ‘They each *dou* has some advantages.’
  3. This analysis cannot be extended to other uses of *dou*.

2.2. The maximality operator analysis (Cheng & Giannakidou 2006, Xiang 2008)

- *Dou* is a maximality operator (≈ *the*) with a plural presupposition; it operates on a set that has been partitioned by covers and picks out the maximal plural individual.

\[
\text{J}_{\text{dou}}(X) = |C| > 1 \land \exists y \in C[\neg\text{Atom}(y) \land \forall z \in C[z \leq y]].
\]

(15) \( \text{J}_{\text{dou}}(X) \) is defined iff the cover of \( X \) is non-singleton and has a unique non-atomic maximal element; when defined, the reference of \( \text{J}_{\text{dou}}(x) \) is this maximal element.

- Problems:
  1. It predicts no distributivity effect. Prediction: “*abc dou* bought houses” asserts that ‘the maximal element in Cov_{abc} bought houses’, not that ‘every element in Cov_{abc} bought houses’.
  2. The plurality requirement comes as a stipulation on the presupposition of *dou*: *dou* presupposes that the selected maximal element is non-atomic.
3. Defining *dou* as a special exhaustifier

3.1. The canonical exhaustifier *only*

- *Only* operates on *excludable* (excl)-alternatives and presupposes the existence of an excl-alternative.

(16) a. \[
\text{\textnormal{[only]}(p) = \lambda w[p(w) = 1 \land \exists q \in \text{Excl}(p) \forall q \in \text{Excl}(p)[q(w) = 0]]}
\]

(\text{[only]}(p) \text{ is defined iff } p \text{ is true and } p \text{ has some excl-alternative(s); when defined, [only]}(p) \text{ is true iff the excl-alternatives of } p \text{ are false.})

b. \[
\text{Excl}(p) = \{ q : q \in \text{Alt}(p) \land p \not\subseteq q \}
\]

(The set of alternatives that are not entailed by the prejacent)

Illustrating the additive presupposition: *only* is odd in (17b) because the prejacent is the strongest among the alternatives.

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

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

b. # Only BOTH.

c. BOTH.

3.2. Defining *dou* in analogous to *only*

- In analogous, *dou* operates on pre-exhaustified sub-alternatives and presupposes the existence of a sub-alternative. Sub-alternatives are complements of excl-alternatives. Pre-exhaustification effect is realized by applying an \(O\)-operator to each sub-alternative.

(18) a. \[
\text{\textnormal{[dou]}(p) = \lambda w[\exists q \in \text{Sub}(p)p(w) = 1 \land \forall q \in \text{Sub}(p)[O(q)(w) = 0]]}
\]

(\text{[dou]}(p) \text{ is defined iff } p \text{ has at least one sub-alternative; when defined, [dou]}(p) \text{ is true iff } p \text{ is true and the exhaustification of each sub-alternative of } p \text{ is false.})

b. \[
\text{Sub}(p) = (\text{Alt}(p) - \text{Excl}(p)) - \{ p \}
\]

(To be revised)

(The set of alternatives that are not excludable and distinct from the prejacent)

(= The set of alternatives that are weaker than the prejacent)

c. \[
O(p) = \lambda w[p(w) = 1 \land \forall q[q(w) = 1 \rightarrow p \subseteq q]]
\]

(Chierchia et al. 2012)

A toy example: The anti-exhaustification condition (underlined) is entailed by the prejacent.

(19) [a and b] *dou* came.

a. \[
\text{Alt}(a \oplus b) = D_e
\]

b. \[
\text{[S]} = \text{came}'(a \oplus b)
\]

c. \[
\text{Alt}(S) = \{ \text{came}'(x) : x \in D_e \}
\]

d. \[
\text{Sub}(S) = \{ \text{came}'(a), \text{came}'(b) \}
\]

e. \[
\text{[dou}(S)\text{]} = \text{came}'(a \oplus b) \land \neg O[\text{came}'(a)] \land \neg O[\text{came}'(b)]
\]

(20) [John] (*dou*) came. (ungrammatical unless John is stressed)

a. \[
\text{[S]} = \text{came}'(j)
\]

b. \[
\text{Sub}(S) = \emptyset
\]

c. \[
\text{[dou}(S)\text{]} \text{ is undefined}
\]
4. Predicting the quantifier-distributor use

- I argue that the requirements of maximality and plurality are illusions. All the facts that are thought to result from these two requirements actually result from the presupposition of *dou*.

4.1. Deriving the “distributivity requirement”

- In (21), under a single-cover/collective reading, no alternative is asymmetrically entailed by the prejacent and no sub-alternative is available, making the use of *dou* undefined.\(^2\)

\[
(21) \quad \text{"abc} \text{dou bought houses."}
\]

- In the alternatives, \(C\) constantly denotes the contextually determined cover of the associated item in the prejacent (viz. the cover of \(a \oplus b \oplus c\), and \(\text{Part}\) only distributes over \(C\). (See Liao 2012: ch. 4.) For example, if \(C = \{a, b, c\}\), the alternative \(\text{Part}_{C}(f, d)\) is vacuously a tautology, and the alternative \(\text{Part}_{C}(f, a \oplus b \oplus c \oplus d)\) is logically equivalent to \(\text{Part}_{C}(f, a \oplus b \oplus c)\).

These consequences are fine for now. Nevertheless, problems arise in case that we want an operator to operate on excl-alternatives. For example, to derive the exhaustification inference of (3), ‘b bought houses’ shall not be a tautology.

\[
(1) \quad \text{abc} f \text{ bought houses.} \quad \sim d \text{ didn’t bought houses.}
\]

See a solution in Liu (2016) based on Link-Landman’s approach of encoding distributivity/collectivity distinction.
4.2. Deriving the “plurality requirement”

- This plurality is illusive; it is neither necessary nor sufficient.

  - Unnecessary: *dou* can be associated with an atomic element as long as the predicate is divisive.

    (25) Yuehan ba [na-ping shei] *dou* he -le (*yi-ban).
    John BA that-bottle water DOU drink -ASP one-half
    a. √’J had that bottle of water.’ ⇒ If \( x \) is part of that bottle of water, J had \( x \).
    \[ \text{Sub}(\text{J had that bottle of water}) = \{ \text{J had } x : x < \text{that bottle of water} \} \]
    b. ×’J had half of that bottle of water.’ \( \not\Rightarrow \) If \( x \) is part of that bottle of water, J had half of \( x \).
    \[ \text{Sub}(\text{John had half of that bottle of water}) = \emptyset \]

  - Insufficient: when applied to a statement with a *divisive* collective predicate, *dou* requires its associated item to denote a group containing at least 3 members. This is so because collective predicates are undefined for proper subparts of a dual-individual (i.e. atomics).

    (26) ‘*ab* (*dou*) are friends.’
    a. \[ \text{[are friends]} = \lambda x[\neg\text{Atom}(x).\text{be-friends}(x)] \]
    b. \[ \text{Sub}(\text{ab are friends}) = \emptyset \]

5. FCI-licenser use

5.1. Licensing conditions of Mandarin FCIs

- The English polarity item *any* is licensed as a \( \forall \)-FCI when appearing over a possibility modal, but not when it appears in an episodic statement or over a necessity modal.

  (27) a. * Anyone came in. \quad \text{Episodic statements}
  b. Anyone can come in. \( \approx \) Everyone can come in. \quad \text{Over possibility modals}
  c. * Anyone must come in. \quad \text{Over necessity modals}

- In Mandarin, the \( \forall \)-FCI use of a disjunction is only licensed in a pre-*dou+\( \Diamond \) position.

  (28) \[ \text{[Yuehan huoze Mali] *dou* (keyi)/*bixu jiao jichu hanyu.} \]
  John or Mary DOU can/must teach intro Chinese
  Intended: ‘Both John and Mary can teach Intro Chinese.’

  But the \( \forall \)-FCI use of a bare *wh*-word can be licensed without a modal. (Giannakidou & Cheng 2006)

  (29) \[ \text{[Shei] *(dou) dao -le.} \]
  who\text{fcI} DOU arrive -ASP.
  ‘Everyone arrived.’

The licensing conditions for *na-cl-NP* ‘which-NP’ and *renhe-NP* ‘any-NP’ are less clear. They can be licensed in a pre-*dou+\( \Diamond \) position. Judgements for other contexts vary a lot.

\[ \text{There are, however, variations with this judgement.} \]
5.2. Deriving the ∀-FC inferences

- Wh-items are existential indefinites; thus the plain meaning of (29) is equivalent to a disjunction. Sub-alternatives of a disjunction are the disjuncts. Applying *dou* yields a ∀-FC implicature.

(29) “Shei *dou* arrived.”

a. **[shei arrived]** = \( f(a) \lor f(b) \)

b. **Sub(shei arrived)** = \( \{ f(a), f(b) \} \)

c. **[dou [shei arrived]]** = \( [f(a) \lor f(b)] \land \neg O f(a) \land \neg O f(b) \)
   = \( [f(a) \lor f(b)] \land [f(a) \rightarrow f(b)] \land [f(b) \rightarrow f(a)] \)
   = \( f(a) \land f(b) \)

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<td>Sub-alternatives are the complements of “innocently (I)-excludable” alternatives.</td>
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(30) a. **Sub-alternatives**

\( \text{Sub}(p) = (\text{Alt}(p) - \text{IExcl}(p)) - \{p\} \)

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

b. **Innocently (I)-excl-alternatives** (Fox 2007)

\( \text{IExcl}(p) = \bigcap \{ A : A \text{ is a maximal subset of } \text{Alt}(p) \text{ s.t. } A^\downarrow \cup \{p\} \text{ is consistent} \} \)

where \( A^\downarrow = \{ \neg q : q \in A \} \)

(q is I-excludable to p iff q is included in every maximal set of alternatives of p s.t. the exclusion of this set is consistent with p.)

- Disjuncts are not I-excludable:

\( \{ p \lor q \} \) is inconsistent with \( \{ p, q \}^\downarrow: \quad [p \lor q] \land \neg p \land \neg q = \bot \)

- Non-excludable alternatives are also not I-excludable. Hence, this revision doesn’t change the derivation of the quantifier-distributor use of *dou*.

\( ^4 \)This derivation looks very close to that of applying Fox’s (2007) recursive exhaustifier \( O_R \) or Chierchia’s (2013) pre-exhaustification operator \( O_{\text{pre}} \). But *dou* is not exactly \( O_R/O_{\text{pre}} \). First, unlike \( O_R \), *dou* does not negate the I-excludable alternatives and hence doesn’t yield an exhaustification inference. Second, while \( O_{\text{pre}} \) operates on domain alternatives, which are grammatically defined, *dou* operates on sub-alternatives, which are defined purely semantically. See Xiang (2016: §2.7) for more details.

\( ^5 \)Another commonly seen definition of I-excl-alternatives is (1), which, however, is inadequate.

(1) \( \text{IExcl}(p) = \{ q : q \in \text{Alt}(p) \land \neg \exists q' \in \text{Excl}(p)[[p \land \neg q] \rightarrow q'] \} \)

(The set of alternatives p such that affirming p and negating q does not entail any excl-alternatives)

For example, in (2), where the prejacent is the strongest among the alternatives and thus has no excl-alternative, the condition underlined in (1) is vacuously satisfied; therefore, definition (1) predicts that every alternative of p is I-excludable.

(2) EVERY student came.
5.3. Explaining other licensing conditions

• **In licensing the FCI use of a pre-verbal wh-word, the use of dou is mandatory.**

When a wh-word has a non-interrogative use, its sub-alternatives are obligatorily activated and must be used by a c-commanding exhaustifier. (Liao 2012, Chierchia & Liao 2015) When dou is absent, these sub-alternatives would have to be used by a basic O-exhaustifier\(^6\) yielding a contradiction:

\[
\begin{align*}
[O \text{ [shei arrived]}] &= O[f(a) \lor f(b)] \\
&= [f(a) \lor f(b)] \land \neg f(a) \land \neg f(b) \\
&= \bot
\end{align*}
\]

• **Modal Obviation: licensing the \(\forall\)-FCI use of a pre-verbal disjunction needs a weak modal.**

A focused disjunction obligatorily triggers a scalar implicature (SI).

In a non-modalized context, the \(\forall\)-FC implicature clearly contradicts the SI, therefore FC-disjunctions are not licensed in episodic statements. (Same as Chierchia 2013 on English *any*)

\[
\forall\text{-FC: } f(j) \land f(m) \quad \text{SI: } \neg[f(j) \land f(m)]
\]

In a modalized context, the SI restricts the modal base \(M\) to the set of worlds where the SI is true\(^7\)

\[
(32) \quad [\text{John or Mary}] \text{ dou can teach Intro Chinese.}
\]

• **Remaining puzzle:** Why is that licensing the \(\forall\)-FCI use of who doesn’t require a weak modal?

A possibility: bare wh-words do not generate SIs.

But this assumption makes it hard to capture the epistemic indefinite use of Mandarin wh-words. (See Chierchia & Liao 2015.)

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\(^6\)The sub-alternatives of a pre-verbal item cannot be used by a covert dou (or any other covert pre-exhaustification exhaustifier), due to the economy condition for language-particular operations: “don’t do covertly what you can do overtly” (Chierchia 1998). Since dou is a language-particular particle, overt dou and covert \(O_{\text{noc}}\) have complementary distributions.

\(^7\)Alternative approaches in the realm of exhaustifications include Dayal (2009) and Chierchia (2013). Dayal assumes a Fluctuation Constraint: in an *any*-sentence, the intersection of the restriction and the scope that verifies the sentence should not be constant across the accessible worlds. Chierchia assumes a Modal Containment Constraint: the FC and scalar implicatures have different modal bases; in particular, the one for FC is a proper subset of the one for SI.
6. Scalar marker

6.1. The [lian...dou...] construction

• A [lian...dou...] sentence evokes an even-like reading:

(34) **Lian** [LINGDAO]_F **dou** chidao -le.

lian leader DOU late -ASP

‘Even the leader was late.’

• English even triggers an existential scalar presupposition: the propositional argument is less likely than some contextually relevant alternative. (Bennett 1982, Kay 1990; cf. Karttunen & Peters 1979)

(35) \[ \text{[even]}(p) = \exists q \in C[q >_{\text{likely}} p].p \]

([even](p) is defined only if \( p \) is more likely than some contextually relevant alternative; when defined, \([\text{even}](p) = p\)

• Getting the even-like reading of [lian...dou...]

When dou agrees with a lian-NP (or a non-scalar focused item), the measurement for ordering alternatives gets shifted from logical strength to likelihood. Sub-alternatives are the ones more likely than the prejacent. The pre-exhaustification effect is realized by the scalar exhaustifier just.

(36) a. \( \text{Sub}(p) = \{ q : q \in \text{Alt}(p) \land q >_{\text{likely}} p \} \)

(The set of \( p \) that are more likely than \( p \))

b. \( \text{Just}(q) = \lambda w[q(w) = 1 \land \forall r \in \text{Alt}(q)[r(w) = 1 \rightarrow p >_{\text{likely}} r]] \)

(\( q \) true, and \( q \) is the most likely proposition among its true alternatives.)

We get a dou semantically equivalent to even (see computation in (38)): the additive presupposition of dou is the scalar presupposition of even; the assertion is vacuous.

(37) \[ \text{[dou]}(p) = \lambda w[\exists q \in \text{Sub}(p). p(w) = 1 \land \forall q \in \text{Sub}(p)[\text{just}(q)(w) = 0]] = \text{[even]}(p) \]

(38) \[ \text{[dou]}(p) = \exists q \in \text{Sub}(p).p \land \forall q \in \text{Sub}(p)[\neg \text{just}(p)] \]

\( = \exists q \in \text{Sub}(p).\lambda w[p(w) = 1 \land \forall q \in \text{Sub}(p)\exists r \in \text{Alt}(q)[r(w) = 1 \land q >_{\text{likely}} r]] \]

\( = \exists q \in \text{Alt}(p)[q >_{\text{likely}} p]. \lambda w[p(w) = 1 \land \forall q \in \text{Alt}(p)[q >_{\text{likely}} p \rightarrow \exists r \in \text{Alt}(q)[r(w) = 1 \land q >_{\text{likely}} r]]] \]

\( = \exists q \in \text{Alt}(p)[q >_{\text{likely}} p].p \)

[Whenever \( p \) is true, then any alternative of \( p \) that is more likely than \( p \) is less likely than some true alternative \( r \), where \( r = p \).]

---

*Karttunen & Peters (1979) assumes a universal scalar presupposition: the propositional argument of even is less likely than all of its alternatives that are not identical to it. This presupposition is too strong. An even-sentence can also describe a non-extreme case. Examples in (2) are from Kay (1990/90).

1. \[ \text{[even]}(p) = \forall q \in C[p \neq q \rightarrow q >_{\text{likely}} p].p \]

2. a. Not only did Mary win her first round match, she even made it to the semi-finals.

   b. The administration was so bewildered that they even had lieutenant colonels, making policy decisions.
6.2. Minimizer-licensing

- **Fact 1:** Minimizers can be licensed in [lian MIN dou ...]. A post-*dou* negation is usually mandatory:

  (39) Yuehan (lian) [YI-ge ren] F *([dou] '(bu) renshi.
  John lian one-cl person dou neg know
  ‘John doesn’t know anyone.’

  **Analysis:** Interpreting (39) involves reconstructing the minimizer, so as to satisfy the presupposition of *dou*. Without negation or if the minimizer scopes above negation, the prejacent clause of *dou* is logically the weakest among its alternatives (a la Crinč 2011 on English even).

  (40) For any $n > 1$:
  a. $\exists x \neg[\text{know}^\prime(j, x)] \iff \exists n x \neg[\text{know}^\prime(j, x)]$ MIN $>$ NEG
  b. $\neg\exists x [\text{know}^\prime(j, x)] \Rightarrow \neg\exists n x [\text{know}^\prime(j, x)]$ NEG $>$ MIN

  A minimizer cannot be licensed if it cannot be reconstructed to a position below negation.

  (41) * (Lian) [YI-ge ren] F dou bu renshi Yuehan.
  lian one-cl person dou neg know John.
  Intended ‘no one knows John.’

  - **Fact 2:** The post-*dou* negation is optional in (42).

    (42) Yuehan (lian) [YI-fen qian] F *([dou] (bu) xiang yao.
    John lian one-cent money dou neg want request
    With negation: ‘John doesn’t even want one cent.’
    Without negation: ‘John wants it even if it is just one cent.’

    **Analysis:** The desire predicate *xiang* ‘want’ is non-monotonic (Heim 1992, a.o.). If the minimizer takes scope below *xiang*, the alternatives are semantically independent.

    (43) $[\text{dou} [\text{John}, \text{want}_{NM} [\text{one-cent} \lambda x [\text{e, has } x ]]]]$

    We can order the alternatives based on likelihood. Sub-alternatives are the ones more likely than the prejacent: it is more likely that John wants more than one cent.

6.3. Associating with a scalar item

- Associating *dou* with a scalar item implies that the prejacent ranks relatively high in the contextually relevant scale. The associated item can appear on the right side of *dou* but must be stressed.

  (44) a. It is *dou* FIVE o’clock! $\sim$ It’s too late.
  b. John *dou* has eaten THREE burgers! $\sim$ John has eaten too much.

  When *dou* agrees with a focused scalar item, alternatives are ordered w.r.t. a contextually determined measurement $\mu$. Sub-alternatives are the ones ranking lower than the prejacent w.r.t. $\mu$. The pre-exhaustification effect is realized by the scalar exhaustifier JUST.

  (45) $[\text{dou}] (p) = \lambda w [\exists q \in \text{Sub}(p). \ p(w) = 1 \land \forall q \in \text{Sub}(p) [\text{just}(q)(w) = 0]]$
  a. $\text{Sub}(p) = \{q : q \in \text{Alt}(p) \land p \succ_\mu q\}$
  (The set of alternatives of $p$ that rank lower than $p$ w.r.t. $\mu$)
b. \( \text{just}(q) = \lambda w[q(w) = 1 \land \forall r \in \text{Alt}(p)[r(w) = 1 \rightarrow r \geq \mu] \quad (r \text{ is true; } r \text{ ranks the highest w.r.t. } \mu \text{ among its true alternatives.)} \)

A toy example:

\[ (46) \quad \textbf{Dou} [WU}_{F\text{-dian}] -\text{le.} \\
\text{dou} \text{ five-o’clock } -\text{ASP} \\
\text{‘It is dou FIVE o’clock.’} \]

a. \( \text{Sub (it’s 5 o’clock)} = \{ \text{it’s 4 o’clock, it’s 3 o’clock, …} \} \)

b. \( [\text{dou [it’s 5 o’clock]]} = \text{‘it’s 5, not just 4, not just 3, …’} \)

7. Sorting the parameters: Logical strength vs. likelihood

- Two basic ways to define sub-alternatives:
  
  Def A: weaker than the prejacent; (based on logical strength)
  
  Def B: more likely than the prejacent. (based on likelihood)

  Def A is strictly stronger than Def B: due to rule (47), if a proposition is logically weaker than the prejacent, it is also more likely than the prejacent; but not the other direction.

  (47) Entailment and scalarity (Crinč 2011:15)
  
  If \( p \subset q \), then \( p <_{\text{likely}} q \).

- Assuming that the logical strength-based semantics is basic, and that the likelihood-based semantics is derived and is only licensed in \([\text{lian}...\text{dou}...]\), I predict the following distributional pattern of dou:

<table>
<thead>
<tr>
<th>If the prejacent is ...</th>
<th>Can dou be licensed in...</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(i) basic declaratives?</td>
</tr>
<tr>
<td>a. the logically strongest alt</td>
<td>Yes</td>
</tr>
<tr>
<td>b. the logically weakest alt</td>
<td>No</td>
</tr>
<tr>
<td>c. neither</td>
<td>No</td>
</tr>
</tbody>
</table>

The prediction for (c-i) is empirically supported (capitalizing marks stress):

(48) a. They \textbf{dou} bought houses. \(#\text{collective, } \sqrt{\text{distributive}}\)

b. (Lian) THEY \textbf{dou} bought houses. \((\sqrt{\text{collective}}, \sqrt{\text{distributive}})\)

(49) a. * John \textbf{dou} arrived.

b. (Lian) JOHN \textbf{dou} arrived.

\footnote{For now, I have to neglect the complications of innocent excludability. If an alternative is stronger but not I-excludable, it is still less likely than the prejacent. One option is to pursue the following path, where the even-like and FCI-licenser uses of \textit{dou} are derived from the distributor-quantifier use by weakening the def of sub-alternatives.}

The derivation path of sub-alternatives: \(A \xrightarrow{B} C\) where

A. \( \text{Sub}(p) = (\text{Alt}(p) - \text{Excl}(p)) - \{p\} \)

B. \( \text{Sub}(p) = \{ q : q \in \text{Alt}(p) \land q >_{\text{likely}} p \} \)

C. \( \text{Sub}(p) = (\text{Alt}(p) - I\text{Excl}(p)) - \{p\} \)

\footnote{This idea is supported by diachronic evidence. The quantifier-distributor use of \textit{dou} emerges as early as the Eastern Han Dynasty (25-220) (Gu 2015), while the even-like use in the \([\text{lian}...\text{dou}]\) construction emerges around the Ming Dynasty (1368-1644). I thank Feng Gu (p.c.) for data in Ancient Chinese.}
The prediction for (c-i) favors my proposal over Liu’s (2016). Liu treats the likelihood-based semantics as the default semantics of *dou*. But, if this were the case, *dou* should be licensed whenever its likelihood-based semantics is satisfied, and hence should have the same distribution in (i) and (ii), contra the fact.

For example, for (48a), if ‘they bought houses together’ >likely ‘the others bought houses together’, the likelihood-based semantics of *dou* would be licensed even if the prejacent takes a collective reading.

8. Conclusions

- *Dou* is a special exhaustifier which (i) operates on pre-exhaustified sub-alternatives and (ii) presupposes the existence of a sub-alternative.

  Default case (distributor and FCI-licenser):

  \[(dou)(p) = \lambda w[\exists q \in Sub(p). p(w) = 1 \land \forall q \in Sub(p)[O(q)(w) = 0]]\]

  i. Presupposition: the prejacent has some sub-alternative(s).
  ii. Assertion: the prejacent is true, the exhaustification of each sub-alternative is false.

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

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

Scalar marker

\[(dou)(p) = \lambda w[\exists q \in Sub(p). p(w) = 1 \land \forall q \in Sub(p)[\text{Just}(q)(w) = 0]]\]

\[\text{Sub}(p) = \{q : q \in \text{Alt}(p) \land q >\text{likely} p\}\] if in a \[\text{lian} \ldots \text{dou} \ldots \] construction

\[\text{Sub}(p) = \{q : q \in \text{Alt}(p) \land q <\mu p\}\] if associated with a scalar item

- The presupposition of *dou* is responsible for the derivation of ∀-FC inferences.

- The presupposition of *dou* is responsible for:
  i) the distributivity and plurality requirements of distributor/quantifier-*dou*,
  ii) the even-like semantics of a [lian...dou...] construction,
  iii) the licensing conditions of minimizers in [lian MIN dou...] constructions,
  iv) the scalar inferences in cases where *dou* is associated with a scalar item.

Appendix: Alternative proposals in the realm of exhaustifications

Liao (2012: ch. 4)

- The particle *dou* is a focus indicator and has no meaning *per se*. It signals the use of an E-operator \(\approx\text{even}\) (Krifka 1995, Chierchia 2013) and assigns an [+add] feature to the \(\sim\)-operator (Rooth 1985).

\[(E[\sim_{[+add]}, C _{[douP \ \text{they}]} \ _{[dou \ t_i \ arrived } ]])\]

a. \[E(p) = \forall q \in \text{Alt}(p)[p \neq q \rightarrow p <\text{likely} q],p\]

b. \[\sim_{[+add]}, C(p) = \lambda w[\exists q \in C[q \neq p \land q(w) = 1] \land \forall q \in C[q \neq p \rightarrow (\Diamond q)(w) = 1]].p\]

The even-like meaning is due to the presupposition of the E-operator. This presupposition is trivially satisfied when *dou* applies to a distributive statement.

When *dou* is associated with a *wh*-item, the presupposition of the \(\sim_{[+add]}, C\)-operator forces the prejacent to be recursively exhaustified, yielding a ∀-FC inference.
• Problems:

1. The *even*-inference of a *dou*-clause is always local. The locality effect is not predicted: if a downward-entailing operator is inserted between *E* and *dou*, we wouldn’t get the *even* reading.

   (54) If lian JOHN\(_F\) *dou* came, Mary would be happy.
   \(\sim\) John is less likely to come compared with others.
   a. If *E* [lian JOHN\(_F\) *dou* came], Mary will be happy \(\checkmark\)
   b. *E* [if lian JOHN\(_F\) *dou* came, Mary will be happy] \(\times\)

2. The additive presupposition is too strong.

   (55) (Lian) JOHN\(_F\) *dou* passed the exam, how come that the others all didn’t!

3. In (53), due to the Relativized Minimality, the *E*-operator has nothing to be associated with. Liao assumes that *E* is then associated with *IP*, whose focus value is purely determined by context.

4. The violation to the additive presupposition of the \(\sim\)-operator could also be salvaged by any *DE* operators, and then the \(\forall\)-FC inference wouldn’t be forced, contra the fact.

   (56) He didn’t what *dou* buy.
   Predicted LF: \([E \sim [+add], C [not [what, [dou [he bought t] ]]]]])
   a. Desired reading: He didn’t buy everything, (but he still bought something.)
   b. Predicted reading: He didn’t buy anything.

Liu (2016)

- Liu (2016) adopts Karttunen & Peter’s (1979) semantics of *even* and defines *dou* as equal to *even*:

   (57) \([dou](p) = \forall q \in Alt(p)[p \neq q \rightarrow p \lessdot likely q].p\)

   (dou is truth conditionally vacuous but presupposes that its prejacent is the most unlikely proposition among its alternatives.)

When *dou* applies to a distributive statement, the prejacent entails all the alternatives, and thus the presupposition gets trivially satisfied.

Liu (2016) also make improvements on the treatment of distributivity/collectivity in the derivation of alternatives.

• Problems:

1. Treating *dou* as *even* is incompatible with the fact that *dou* has more limited distribution in basic declaratives than in [lian ... *dou*...] constructions. (See section 7)

2. The universal scalar presupposition is too strong. *Doun* can be used in non-extreme cases.

   (58) a. [The kids] *dou* arrived, the teachers also arrived.
   b. only [the kids] arrived, # the teachers also arrived.
References


Rooth, Mats. 1985. Association with focus. Doctoral Dissertation, University of Massachusetts, Amherst, MA.

