Diversity of intervention effects: Unifying three Mandarin *dou* constructions

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I propose a novel and principled way to combine question and focus semantics and show that it provides a unified semantic account of three Mandarin constructions with the preverbal particle *dou*, including their ordering restrictions, in terms of various intervention effects.

The first *dou* construction has a scalar presupposition (1). If the focused constituent (optionally marked with *lian*) is the object, it must appear **before** *dou*, either sentence initially or between the subject and *dou*; the basic SVO word order is ungrammatical.

(1) [·] Yuehan [·] dou   piping   le   *[(lian) Mali$_F$]/$^\checkmark$__
     [·] John   [·] DOU criticize PFV   LIAN Mary / GAP

'John criticized even Mary' ([·] indicates alternative positions of the constituent in [])

Second, *dou* exhaustifies a wh-question (2): without *dou* the wh-question admits non-exhaustive answers. In this case the wh-phrase must appear **after** *dou*.

(2) *[·] Yuehan *[·] dou   piping   le   [shui$_F$] ?
     [·] John   [·] DOU criticize PFV   who   ?

'What all did John criticize?'   exhaustive wh-question

The third construction has a wh-indeterminate (optionally marked with *wulun*) associated with *dou* and has a universal reading (3). The wh-indeterminate, similar to the *lian*-focus in (1), must appear **before** *dou* and is therefore in complementary distribution with (2).

(3) [(wulun) shui$_F$] Yuehan [·] dou   piping   le   *[·]/$^\checkmark$__ .
     no.matter who   John   [·] DOU criticize PFV   [·]/ GAP .

'John criticized everyone'   wh *dou* construction

Previous analyses of *dou* tend to overlook or exclude the use of *dou* in exhaustive questions and treat the ordering restrictions in (1-3) as syntactic idiosyncrasies. I argue that, with a proper semantics of *dou* as a wh-question exhaustifier, they are results of intervention effects. I introduce a new Roothian style two-dimensional system to combine question and focus semantics, with two main features: (i) the denotation of an expression is a set of ordinary-alternative value pairs, and (ii) *inquisitiveness* resides in ordinary values, i.e., ordinary values are Hamblin/Kratzer-Shimoyama style sets. Despite these differences from Rooth's original system, his main insight is maintained: the alternative value of an unfocused expression is the singleton set containing the ordinary value, whereas the alternative value of a focused expression is a set of contextually relevant ordinary values. For example, the denotation of *who$_F$* has only one ordinary-alternative value pair (4a). Its ordinary value is the set of humans, and its alternative value (since it is focused) is the set of relevant ordinary values, i.e., singleton sets of humans (e.g., $\{\mathbf{m}\}$, which is $[\![\text{Mary}]\!]^o$). Semantic composition in this new system is functional application or recursive pointwise composition, whichever is applicable.[1]

(4) a. $[\![\text{who}_F]\!] = \{\langle\{y \mid y \in D_{\text{human}}\}, \{\{y\} \mid y \in D_{\text{human}}\}\rangle\}$

	John	criticized	who$_F$		John criticized who$_F$
b. $[\![\cdot]\!]^o$	$\{\mathbf{j}\}$	$\{\mathbf{crit}\}$	$\{\mathbf{m}, \mathbf{b}, \mathbf{j}\ldots\}$	$\Rightarrow [\![\cdot]\!]^o$	$\{\mathbf{crit}(\mathbf{m})(\mathbf{j}), \mathbf{crit}(\mathbf{b})(\mathbf{j}), \mathbf{crit}(\mathbf{j})(\mathbf{j})\ldots\}$
$[\![\cdot]\!]^a$	$\{\{\mathbf{j}\}\}$	$\{\{\mathbf{crit}\}\}$	$\{\{\mathbf{m}\}, \{\mathbf{b}\}, \{\mathbf{j}\}\ldots\}$	$[\![\cdot]\!]^a$	$\{\{\mathbf{crit}(\mathbf{m})(\mathbf{j})\}, \{\mathbf{crit}(\mathbf{b})(\mathbf{j})\}, \{\mathbf{crit}(\mathbf{j})(\mathbf{j})\}\ldots\}$

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[1] The result of composing m and n, i.e., $m \circ n$, is (i) $m(n)$ or $n(m)$ if one can take the other as argument, (ii) $\langle m^o \circ n^o, m^a \circ n^a\rangle$ if both m and n are pairs, or (iii) $\{x \circ y \mid x \in m, y \in n\}$ if both m and n are sets. This compositional system is essentially stacking Charlow's (2014) focus and set monads and is fully principled.

The interrogative force [?] is applied to a ordinary-alternative value pair to compute its discourse effect. It ensures a proper Hamblin-style question denotation in the ordinary value (5; inspired by Roelofsen & Farkas 2015) and requests that the listener commit to at least one proposition in it. As a result, *John criticized who?* admits non-exhaustive answers.

(5)   Let $\langle m', n' \rangle = [?](\langle m, n \rangle)$. $m' = \{p, \neg p\}$ if $m = \{p\}$ is a singleton, otherwise $m' = m$

To derive the denotation of the exhaustive question, I propose that *dou* distributes the alternative values of its argument to create many ordinary-alternative pairs (6).

(6) $[\![\text{DOU } \phi]\!] = \bigcup_{\langle m,n \rangle \in [\![\phi]\!]} \{\langle m \cap y, \{y\} \rangle \mid y \in n\}$ [2]   (see also Fig. **A1**)

Then, given our composition rule, these pairs, in a parallel fashion, enter the remaining composition (**A2**) and get their discourse effects computed (**A3**). In the final derivation of (2), the question operator [?] takes each ordinary value and creates a corresponding yes-no question (**A4**). In this case, the effect of (2) is "for each x, the speaker asks the listener whether John criticized x." The listener's answer is thus required to simultaneously address all these yes-no questions, i.e., it must be exhaustive. Such exhaustification can be achieved only when the wh-phrase is under the scope of *dou*. Since *dou*, like many other Chinese expressions, only takes surface scope, the wh-phrase must appear after *dou* in (2).

The semantics of *dou* in (6) and independent semantic constraints in the other two constructions interact to derive the remaining ordering restrictions. For the wh *dou* construction (3), I adapt Rawlins's (2013) analysis of English unconditionals and assume a universal closure [∀] at the root level, which is licensed by *dou* and licenses the optional *wulun*. Crucially, [∀] has an *anti-singleton requirement* (7a), independently motivated by (7b): the construction is ungrammatical if the *wulun*-phrase is non-inquisitive (*Mali he Su* 'Mary and Sue', as opposed to *Mali haishi Su* 'Mary or Sue', which can be used to form alternative questions).

(7)   a. $[∀](\langle m, n \rangle) = \langle \{\bigwedge m\}, n \rangle$ if m is not a singleton, otherwise an error occurs

       b. Wulun   Mali haishi/*he Su Yuehan dou   piping   le   __   .
          no.matter Mary or/and   Sue John   DOU criticize PFV GAP .

       'John criticized Mary and Sue.'

If the wh-indeterminate appears after *dou* in (3), we would have the same derivation up to the root (**A2**) but will then apply universal closure [∀] rather than [?]. Note that in this case the ordinary value in each pair is a singleton set, which violates the anti-singleton requirement of [∀]. This explains why the wh-indeterminate cannot appear after *dou* in (3). In contrast, when the wh-indeterminate appears before *dou*, since *criticized* is unfocused and hence has a singleton set as its alternative value, composing it with *dou* does not change the denotation (**B1**). After the whole sentence has been composed, the informative content asserted is $\mathbf{crit(m)(j)} \wedge \mathbf{crit(b)(j)} \wedge \ldots$, which is the desired universal reading (**B2**).

Finally, for the *lian ... dou* construction, composing the *lian*-focus and *dou* results in empty sets in the ordinary values (**C**), crashing further composition. This explains why the *lian*-focus cannot appear after *dou* in (1). In contrast, when the *lian*-focus appears before *dou*, the derivation is in parallel with (**B**): crucially, there is no crash because *criticized* is unfocused, and at the root level a covert EVEN (licensed by *dou* and licensing the optional *lian*) introduces a presupposition that the ordinary value is the least likely among those in the alternative value, which is the desired scalar presupposition.

This study contributes to the variety of intervention effects in the Syn/Sem interface.

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[2] The restriction in ordinary value $(m \cap y)$ is needed to maintain Rooth's question-answer constraint.

High operator ϕ	Focused constituent α_F	Effect of **DOU** intervening	
[?]	wh$_F$	wh-question exhaustification	
[∀]	(wulun) wh$_F$	anti-singleton requirement violation	(*)
EVEN	(lian) XP$_F$	$\llbracket \cdot \rrbracket^o = \emptyset$, crash in composition	(*)

Table 1. Summary of the intervention effects (configuration: $[\phi \ldots [DOU\ [\ldots \alpha_F\ ]]]$).

criticized who$_F$

$\llbracket \cdot \rrbracket^o$	$\{\mathbf{crit(m), crit(b), crit(j)} \ldots\}$
$\llbracket \cdot \rrbracket^a$	$\{\{\mathbf{crit(m)}\}, \{\mathbf{crit(b)}\}, \{\mathbf{crit(j)}\} \ldots\}$

DOU criticized who$_F$

$\overset{1}{\Rightarrow}$

$\llbracket \cdot \rrbracket^o$	$\{\mathbf{crit(m), crit(b), crit(j)} \ldots\} \cap \{\mathbf{crit(m)}\}$
$\llbracket \cdot \rrbracket^a$	$\{\{\mathbf{crit(m)}\}\}$
$\llbracket \cdot \rrbracket^o$	$\{\mathbf{crit(m), crit(b), crit(j)} \ldots\} \cap \{\mathbf{crit(b)}\}$
$\llbracket \cdot \rrbracket^a$	$\{\{\mathbf{crit(b)}\}\}$
$\llbracket \cdot \rrbracket^o$	$\{\mathbf{crit(m), crit(b), crit(j)} \ldots\} \cap \{\mathbf{crit(j)}\}$
$\llbracket \cdot \rrbracket^a$	$\{\{\mathbf{crit(j)}\}\}$
$\ldots$	$\ldots$

John DOU criticized who$_F$

$\overset{2}{\Rightarrow}$

$\llbracket \cdot \rrbracket^o$	$\{\mathbf{crit(m)(j)}\}$
$\llbracket \cdot \rrbracket^a$	$\{\{\mathbf{crit(m)(j)}\}\}$
$\llbracket \cdot \rrbracket^o$	$\{\mathbf{crit(b)(j)}\}$
$\llbracket \cdot \rrbracket^a$	$\{\{\mathbf{crit(b)(j)}\}\}$
$\llbracket \cdot \rrbracket^o$	$\{\mathbf{crit(j)(j)}\}$
$\llbracket \cdot \rrbracket^a$	$\{\{\mathbf{crit(j)(j)}\}\}$
$\ldots$	$\ldots$

$\{[?]\} \circ$ (John DOU criticized who$_F$)

$\overset{3}{\Rightarrow}$

[?] $\circ$	$\llbracket \cdot \rrbracket^o$	$\{\mathbf{crit(m)(j)}\}$
	$\llbracket \cdot \rrbracket^a$	$\{\{\mathbf{crit(m)(j)}\}\}$
[?] $\circ$	$\llbracket \cdot \rrbracket^o$	$\{\mathbf{crit(b)(j)}\}$
	$\llbracket \cdot \rrbracket^a$	$\{\{\mathbf{crit(b)(j)}\}\}$
[?] $\circ$	$\llbracket \cdot \rrbracket^o$	$\{\mathbf{crit(j)(j)}\}$
	$\llbracket \cdot \rrbracket^a$	$\{\{\mathbf{crit(j)(j)}\}\}$
$\ldots$	$\ldots$	$\ldots$

$\{[?]\} \circ$ (John DOU criticized who$_F$)

$\overset{4}{\Rightarrow}$

$\llbracket \cdot \rrbracket^o$	$\{\mathbf{crit(m)(j)}, \neg\mathbf{crit(m)(j)}\}$
$\llbracket \cdot \rrbracket^a$	$\{\{\mathbf{crit(m)(j)}\}, \{\neg\mathbf{crit(m)(j)}\}\}$
$\llbracket \cdot \rrbracket^o$	$\{\mathbf{crit(b)(j)}, \neg\mathbf{crit(b)(j)}\}$
$\llbracket \cdot \rrbracket^a$	$\{\{\mathbf{crit(b)(j)}\}, \{\neg\mathbf{crit(b)(j)}\}\}$
$\llbracket \cdot \rrbracket^o$	$\{\mathbf{crit(j)(j)}, \neg\mathbf{crit(j)(j)}\}$
$\llbracket \cdot \rrbracket^a$	$\{\{\mathbf{crit(j)(j)}\}, \{\neg\mathbf{crit(j)(j)}\}\}$
$\ldots$	$\ldots$

Fig A. Derivation of *John DOU criticized who$_F$?* 'who all did John criticize?' (2)

criticized

$\llbracket \cdot \rrbracket^o$	$\{\mathbf{crit}\}$
$\llbracket \cdot \rrbracket^a$	$\{\{\mathbf{crit}\}\}$

$\overset{1}{\Rightarrow}$

DOU criticized

$\llbracket \cdot \rrbracket^o$	$\{\mathbf{crit}\}$
$\llbracket \cdot \rrbracket^a$	$\{\{\mathbf{crit}\}\}$

$\ldots \overset{2}{\Rightarrow}$

$\{[\forall]\} \circ$ ((wulun) who$_F$ John DOU criticized)

$\llbracket \cdot \rrbracket^o$	$\{\bigwedge\{\mathbf{crit(m)(j), crit(b)(j), crit(j)(j)} \ldots\}\}$
$\llbracket \cdot \rrbracket^a$	$\{\{\mathbf{crit(m)(j)}\}, \{\mathbf{crit(b)(j)}\}, \{\mathbf{crit(j)(j)}\} \ldots\}$

Fig B. Derivation of *(wulun) who$_F$ John DOU criticized.* 'John criticized everyone.' (3)

criticized Mary$_F$

$\llbracket \cdot \rrbracket^o$	$\{\mathbf{crit(m)}\}$
$\llbracket \cdot \rrbracket^a$	$\{\{\mathbf{crit(m)}\}, \{\mathbf{crit(b)}\}, \{\mathbf{crit(j)}\} \ldots\}$

$\Rightarrow$

DOU criticized Mary$_F$

$\llbracket \cdot \rrbracket^o$	$\{\mathbf{crit(m)}\} \cap \{\mathbf{crit(m)}\}$	
$\llbracket \cdot \rrbracket^a$	$\{\{\mathbf{crit(m)}\}\}$	
$\llbracket \cdot \rrbracket^o$	$\{\mathbf{crit(m)}\} \cap \{\mathbf{crit(b)}\} = \emptyset$	(*)
$\llbracket \cdot \rrbracket^a$	$\{\{\mathbf{crit(b)}\}\}$	
$\ldots$	$\ldots$	(*)

Fig C. Derivation of **John DOU criticized Mary$_F$.* 'John criticized even Mary' (1)

Selected references ∘ Dissertations on *dou*: Lin, J. 1996. (UMass); Liao, H.-C. 2011., Tsai, C.-Y. 2015., Xiang, Y. 2016. (Harvard); Liu, M. 2016. (Rutgers)   ∘ Beck, S. 2006. Intervention effects ... *NLS*