Bridging Distributivity and Free Choice: The Case of Mandarin *Dou*[*]

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Abstract

This paper presents a novel perspective approaching the semantics of mandarin particle *dou*. It leads to a unifying treatment of unconditionals and free choice constructions, which in turn motivates the meta-characterization of distributivity, free choice and unconditionals as all conveying **orthogonality**.

1 The Puzzle of *Dou*

The semantic contribution of the mandarin particle *dou* has attracted a substantial amount of attention in recent literatures (Liu, 2017; Yimei Xiang, 2019, a.o.), in particular because of its ability to co-occur with different types of expressions and activate various semantic effects. This paper focuses on two of them: the **distributive** use and the **free choice** use.

1.1 Distributivity

In its most common use in basic declarative sentences, *dou* is associated with a preceding noun phrase (enclosed in '[·]') and distributes over its subparts with the remnant predicate, as shown in (1).

(1) a. [Tamen] dou du -le san-ben shu.
they **dou** read -ASP three-CL book.
'They *all* read three books.'

b. *Context: On Sunday, Alice, Bob and Charlie rented a boat together and wandered around the canals in Amsterdam.*
[Tamen] (#dou) zu -le yi-sou chuan.
They (#**dou**) rent -ASP one-CL boat.
'They (#all) rented a boat.'

(1a) demonstrates the *distributivity effect* activated by *dou* with the absence of the cumulative/collective reading '*They read three books between them*', while (1b) showcases a *plurality requirement* of *dou*: it requires at least two proper subparts of (the denotation of) its plural associate to satisfy the subsequent predicate. Since the plurality sum of Bill, Bob and Barbara is the only entity that can be truthfully applied to the predicate *rented a boat*, the plurality

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requirement is not satisfied, and *dou* is not licensed[1]. Note that the plurality requirement effectively blocks the collective reading (and induces distributive reading) in (1a). This is not entirely surprising due to the close correlation observed between distributivity and plurality (Landman, 1989, 2012). Moreover, Lin (1998) noticed that the distributivity effect of *dou* is 'generalized' in that it does not necessarily distribute down to atomic subparts. (2a) shows that the distribution can be applied to a sub-atomic level, indicating that '*John ate every part of that apple*'; while (2b) shows that plural/non-atomic subparts are also acceptable, since the predicate *be friends* applies only to plural entities. Therefore, Lin (1998) proposed to treat *dou* as an overt counterpart of the generalized distributor (Schwarzschild, 1996). In §2.1, a detailed analysis of this use of *dou* building on Lin's proposal will be laid out.

(2) a. Yuehan ba [na-ge pingguo] dou chi-le.
John BA that-CL apple **dou** eat-ASP.
'John ate that apple.' (Xiang, 2019)

b. *Context: Alice, Bill and Charlie are mutual friends.*
[Tamen] dou shi pengyou.
They **dou** BE friends.
'They are *all* friends.'

1.2 Free Choice

As mentioned above, *dou* can be associated with pre-verbal *wh*-phrases (3b) or disjunctions etc. (3a) and gives rise to universal free choice (∀-FC) readings. The basic data is given in (3):

(3) a. Wulun Yuehan haishi Mali *(dou) keyi canjia.
no-matter John or Mary **dou** may participate.
'Both John and Mary may participate.'

b. (Wulun) [shenme] shuiguo Yuehan *(dou) keyi chi.
(no-matter) what fruit John **dou** may eat.
'John may eat any fruit.'

Note that in these cases, the alternative-generating expressions associated with *dou* are optionally preceded by *wulun* (no-matter). These constructions share a very similar structure with mandarin *unconditionals*, with *wulun* as the unconditional head, and *dou* in the consequent:

(4) a. (Wulun) paidui shi zai bier jia haishi baobo jia, Yuehan *(dou) keyi qu.
No-matter party BE at Bill house or Bob house, John *(**dou**) may go.
'Whether the party is at Bill's house or Bob's house, John may go.'

b. (Wulun) paidui zai shui jia, Yuehan *(dou) keyi qu.
No-matter party at who house, John *(**dou**) may go.
'No matter whose house the party will be at, John may go.'

This observation motivates an *unconditional* analysis (Rawlins, 2013) of the ∀-FC reading, resonating with a recent trend (e.g. Szabolcsi, 2019). Moreover, as we will see in §2.3, such analysis calls for a schema that resembles the one used for capturing the distributivity effect (more in §2.2), which not only justifies the uniformity of the current proposal, but also provides breeding ground for the insight towards the connection between distributivity and free choice.

[1]The term *plurality requirement* is borrowed from Xiang (2019), but with a different sense. Xiang interpreted it literally as a requirement of plurality/non-atomicity over the associates of *dou* and argued that such requirement is an illusion (as shown in (2)). I agree with this judgment, but instead interpret the term as forcing the plurality on the set of subparts of the associates, and take it as a robust requirement here and henceforth.

2 From Distributivity to Free Choice

2.1 *Dou* as a generalized distributor

In §1.1 it is established that *dou* evokes a *generalized* distributivity effect. Lin (1998) captures such effect by equating *dou* with the generalized distributor (Schwarzschild, 1996). That is, *dou* distributes over a contextually determined plurality *cover* of the associated referent, and induce a universal reading w.r.t. the subsequent predicate. The definition of a plurality *cover* and a preliminary entry for the distributive *dou* is given in (5) and (6), resp.

(5) a. $\mathcal{C}$ is a plurality COVER of x, written as $Cov(x, \mathcal{C})$, iff $\mathcal{C}$ covers x and no proper subset of $\mathcal{C}$ covers x.

b. $\mathcal{C}$ covers x iff (i) $\mathcal{C}$ is a set of subparts of x, (ii) Every subpart of x belongs to some element of $\mathcal{C}$, and (iii) $\emptyset \notin \mathcal{C}$.

(6) Semantics of *Dou* (Lin, 1998, to be revised):

$[\![dou]\!] = \lambda P_{\langle e,st\rangle} \lambda x_e \lambda w_s . \underbrace{\forall y \in \mathcal{C}. P(y)(w)}_{\text{distributivity effect}}$, where $Cov(x, \mathcal{C})$

Intuitively, then, a *cover* of a (plural) entity is a *minimal* set of its subparts whose plurality sum equals the entity itself. Since a cover is allowed to contain plural elements (and sub-atomic elements as well), the 'generality' of the distributivity effect is accounted for. Take (2b) as an example. Assume $x = a \oplus b \oplus c$ denotes the plurality sum of the three individuals Alice, Bob and Charlie. Take $\mathcal{C} = \{a \oplus b, a \oplus c, b \oplus c\}$, then clearly $\mathcal{C}$ covers x, and no proper subset of it does so, thus $Cov(x, \mathcal{C})$. Finally, applying a universal quantification over the elements in $\mathcal{C}$ w.r.t. the predicate *be friends* yields the desired reading: Alice and Bob are friends, Bob and Charlie are friends, and Alice and Charlie are friends.

However, as noted by Xiang (2019) and others, the entry (6) leaves the *plurality requirement* unaccounted for. The missing part is a mechanism to rule out singleton covers. Consider the infelicitous sentence (1b). Again, $x = a \oplus b \oplus c$ denotes the corresponding plurality sum. Now if $\mathcal{C}$ is the singleton set $\{a \oplus b \oplus c\}$, the definition (5) still admits $\mathcal{C}$ as a cover of x; and applying this to the predicate *rented a boat*, we incorrectly predict the sentence to be true. To fix this, we insert the plurality requirement as a presupposition into the revised entry (7) for *dou*:

(7) Semantics of *Dou* (revised)

$[\![dou]\!] = \lambda P_{\langle e,st\rangle} \lambda x_e \lambda w_s . \underbrace{\exists \mathcal{C}. Cov(x, \mathcal{C}) \wedge |\mathcal{C}| > 1}_{\text{plurality requirement}} . \underbrace{\forall y \in \mathcal{C}. P(y)(w)}_{\text{distributivity effect}}$

The new entry would rule out (1b) as a presupposition failure, since there is no non-singleton cover of x whose elements all satisfy the predicate '*rented a boat*' in the given context. In the following, I will attempt to adapt this schema, i.e. the combination of a plurality requirement and a distributivity effect, in order to capture the semantics of *dou* when used in unconditionals and free choice constructions.

2.2 Lifting Conditionals

As discussed in §1.2, a detour through unconditionals would benefit our understanding of Mandarin free choice constructions and the role that *dou* plays in both environments. In Rawlins (2008, 2013), unconditional readings are derived via a universal closure [∀] of a point-wisely composed Hamblin set of conditional sentences. For instance, given the sentence (4a), the antecedent question "*whether the party is at Bill's house or Bob's house*" generates a Hamblin set of possible answers {*The party is at Bill's house*, *The party is at Bob's house*}, which are point-wisely composed with the consequent sentence, producing a set of conditionals {*The party is at Bill's house* ⇒ *John may go*, *The party is at Bob's house* ⇒ *John may go*}. '⇒' is the conditional operator to which one can feed her favorite conditional semantics[2]. Finally, a universal operator closes off the Hamblin set of conditionals, yielding the desired reading "*The party is at Bill's house* ⇒ *John may go* & *The party is at Bob's house* ⇒ *John may go*". This account, although informally introduced here, showcases striking parallels with the schema in (7): the Hamblin set generated by the antecedent question corresponds to the contextual cover, the consequent corresponds to the 'predicate' (applied to each possible answer via conditional composition), and the distributivity effect induced by *dou* provides the universal closure. Moreover, the *plurality requirement* can be viewed as a requirement of the contextual *inquisitiveness* on the antecedent question. I claim that these parallels indeed characterize the semantics of *dou* in unconditionals, and I will flesh it out formally using the notion of *Lifted Conditionals* (Ciardelli, 2016) based on Inquisitive Semantics.

Inquisitive Semantics unifies the semantic denotations of declarative and interrogative sentences using the notion of *issues*. An issue is a non-empty, *downward-closed* set of *information states*, where an information state stands for a set of possible worlds. Therefore, the propositional semantics undergoes a set-theoretic *lift* from sets of possible worlds to sets of sets of possible worlds. An important notion that is used to distinguish between declarative and interrogative sentences – now that they have the same semantic type – is *alternatives*, defined as the maximal elements in an issue.

(8) An information state α is an $\mathsf{alternative}$ of an issue I iff (i) $\alpha \in I$, and (ii) $\neg\exists\alpha'$ s.t. $\alpha' \in I$ and $\alpha \subsetneq \alpha'$. The set of alternatives of an issue P is written as $\mathsf{alt}(I)$.

As a result, we can distinguish between *inquisitive* issues with $|\mathsf{alt}(I)| > 1$ and *non-inquisitive* issues where $|\mathsf{alt}(I)| = 1$. Finally, we will make use of the function info that retrieves the *informative content* of an issue as the *union* of its set of alternatives:

(9) $\mathsf{info}(I) = \bigcup\{\alpha \mid \alpha \in \mathsf{alt}(I)\}$

A lifted conditional operator '>' can be obtained by *lifting* the semantics of the conditional operator '⇒' into its inquisitive counterpart. Here ⇒ is defined simply as material implication (10), with the lifting result given in (11):

(10) Given the set of possible worlds W and two information states $s, t \subseteq W$,
$s \Rightarrow t := \{w \in W \mid w \in W \backslash s \text{ or } w \in Q\}$

(11) Given two inquisitive issues I and I',
$I > I' := \{s \mid \forall\alpha \in \mathsf{alt}(I) : \exists\beta \in \mathsf{alt}(I').s \subseteq \alpha \Rightarrow \beta\}$

Therefore, the issue $I > I'$ contains the set of information states that support the classical material implications between *any* alternative α of I and *some* alternative β of I'. For unconditionals, with inquisitive antecedents and non-inquisitive consequents, (11) can be further simplified[3]:

(12) Given an inquisitive issue I and a non-inquisitive issue I',
$I > I' := \{s \mid \forall\alpha \in \mathsf{alt}(I) : s \subseteq \alpha \Rightarrow \mathsf{info}(I')\}$

[2]Rawlins followed the modal restriction tradition of Lewis and Keenan (1975); Kratzer (1981), a.o.

[3]Besides unconditionals, the lifted conditionals also captures standard *if*-conditionals (and the simplification of disjunctive antecedent), as well as conditional questions. For more details, see Ciardelli (2016).

This corresponds directly to the informal characterization of unconditional semantics given above, and the adaptation of (7) into the semantics of *dou* in unconditionals (written as dou_{Q} to avoid confusion) naturally follows:

(13) $[\![dou_{\mathrm{Q}}]\!] = \lambda P_T \lambda Q_T \lambda s_{st}.\ \underbrace{|\mathsf{alt}(Q)| > 1}_{\text{plurality}}.\ \underbrace{\forall \alpha \in \mathsf{alt}(Q_c) : s \subseteq [\alpha \Rightarrow \mathsf{info}(P)]}_{\text{distributivity effect}}$

As we an see, the schema of *plurality* + *distributivity* is preserved, the only difference being the types of arguments that *dou* takes: in (7) *dou* takes a predicate ($\langle e, t\rangle$) and distributes it over the associated entity (e), whereas in (13) dou_{Q} takes two issues ($T = \langle s, \langle s, t\rangle\rangle$) and connects them with the lifted conditional.

In the rest of the section, I will forge the ∀-FC constructions as in (3) into the same logical skeleton (12), so that (13) can be applied to derive the free choice effect.

2.3 Unconditional ▶ Free Choice

To apply the unconditional analysis to a ∀-FC structure, the first task is to reconstruct the 'antecedent' question and the 'consequent'. To retrieve the antecedent question, we treat the *wh*-phrase as an *identity question* w.r.t. a type e variable u (written as '**?**u'), which will subsequently fill in a vacuous argument position in the following VP predicate and retrieve the consequent. As a result, a Mandarin ∀-FC sentence is reconstructed into an unconditional with a binding relation between the antecedent and the consequent. As an empirical support for such treatment, we observe that the Mandarin copula '*shi*', which is used to impose a (real) identity question (14a), can be inserted between '*wln*' and the *wh*-phrase as in (14b):

(14) a. Ta shi shui?
He BE who
'Who is he?'

b. Wulu shi shui dou keneng yu-dao mafan.
No-matter BE who **dou** may run-into trouble
'Anyone can run into trouble.'

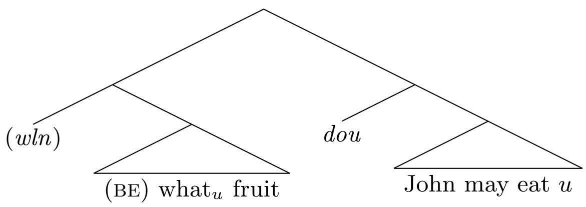
The derivation of ∀-FC effects is now in place. First, $\mathbf{?}u$ is formally characterized as follows:

(15) $\mathbf{?}u := \forall x.\, ?(u = x)$, where $?(u = x) := (u = x) \vee (u \neq x)$.

Let's assume that the identity of u is a piece of information that helps pin down the actual world[4]. Now take the sentence (3b) (repeated below in (16)) as a working example, the unconditional analysis proceeds as follows:

(16) (Wulun) [shenme] shuiguo Yuehan *(dou) keyi chi.
(no-matter) what fruit John **dou** may eat.
'John may eat any fruit.'

a. Assuming the following toy structure:

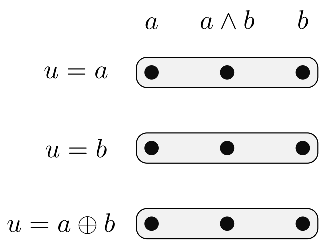


[4]In a dynamic setting, this job can be transferred to the stack of discourse referents, but we won't have space to discuss the detailed implementation

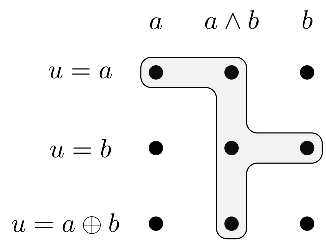
b. $[\![(\text{BE})\ \text{what}_u\ \text{fruit}]\!] = \mathbf{?}u \wedge [\![\text{fruit}]\!](u)$
Suppose the domain of individuals contains two atomic members a, b that are fruits, and their plurality sum $a \oplus b$, then the denotation of $\mathbf{?}u \wedge [\![\text{fruit}]\!](u)$ can be visualized as in Fig. (1a).

c. $\varphi(u) := [\![\text{John may eat } u]\!] = \lambda s_{st}.\forall w \in s : \exists w' \in \text{MB}_d(w).\text{John eat } u \text{ at } w'$

d. Apply the semantics of dou_{Q} (13), we get the following semantic representation of (3b):
$[\![(3b)]\!] = [\![dou_Q]\!](\mathbf{?}u)(\varphi(u)) = \mathbf{?}u > \varphi(u)$, defined only if $|\mathsf{alt}(\mathbf{?}u)| > 1$.
Let $a, b, a \wedge b$ represent the world information that 'John may eat a', 'John may eat b' and 'John may eat a and b', the result is shown in Fig. (1b). The ∀-FC reading is successfully captured, since given any identity of u, the world in which John may eat u is always included.



(a) $?u$



(b) $?u > \varphi(u)$

Figure 1: Derivation of the ∀-FC reading

3 Orthogonality

For an unconditional such as (4a), applying a semantic analysis based on (12) gives rise to the same result as simply asserting the consequent '*John may go to the party*'. One may ask, then, what else is expressed when an unconiditonal is uttered? A key observation made by Rawlins (2013) is that unconditionals convey **orthogonality** between the antecedent issue and the consequent, which means, informally, that asserting the consequent doesn't help (even partially) resolve the antecedent issue. Rawlins further noted that the notion of orthogonality 'provides a powerful and useful unifying meta-characterization of many free choice effects'. The vision will be formally realized in this section. Meanwhile, I argue that the orthogonality effect may be carried to mandarin distributive structures by *dou* as well.

3.1 Orthogonality in Free Choice

The notion of orthogonality can receive a formal characterization from inquisitive semantics, which basically says that for two orthogonal issues I_1, I_2, any alternative of I_1 *cuts across* all the alternatives of I_2, and *vice versa*.

(17) Two issues I_1, I_2 are *orthogonal* if and only if:
For all $p_1 \in \mathsf{alt}(I_1)$, there is no $p_2 \in \mathsf{alt}(I_2)$ s.t. $p_1 \subseteq p_2$, and for all $p_2 \in \mathsf{alt}(I_2)$, $p_1 \cap p_2 \neq \emptyset$;
For all $p_2 \in \mathsf{alt}(I_2)$, there is no $p_1 \in \mathsf{alt}(I_1)$ s.t. $p_2 \subseteq p_1$, and for all $p_1 \in \mathsf{alt}(I_2)$, $p_2 \cap p_1 \neq \emptyset$.

The orthogonality conveyed by (4a) is then illustrated in Fig. (2), where the antecedent question raises two alternatives "*the party is at Bill's house*" and "*the party is at Bob's house*" (enclosed in the gray areas in Fig. (2a)), and the issue denoted by the consequent '*John may go*' (the rectangle in Fig. (2b)) cuts across both of them.

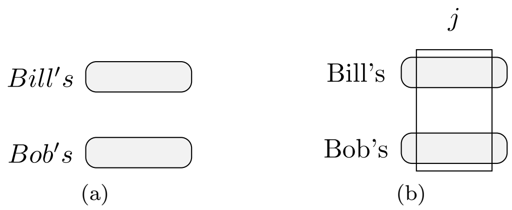


Figure 2: Orthogonality conveyed by (4a)

However, if we adhere to the idea that the orthogonality holds between the antecedent and the *consequent*, a problem occurs as we try to pinpoint the ones conveyed by ∀-FC constructions. Recall that in §2.3, the 'antecedent' of a ∀-FC construction is reconstructed as an identification question $\mathbf{?}u$, while u is co-indexed in the 'consequent' and applied to the remnant predicate. Therefore, the semantic denotation of the 'consequent' actually *depends* on the resolution of the antecedent. This clearly goes against our intuition about orthogonality. Moreover, this problem extends beyond ∀-FC constructions to any unconditional with a binding relation between the antecedent and consequent, as we can see in (18): whenever a (complete) answer of the antecedent question '*who*$_1$ *comes?*' is given, the truth condition of the consequent '*John will invite him/her*$_1$' is fixed.

(18) No matter who$_1$ comes, John will invite him/her$_1$ for dinner.

One might suggest that the orthogonality actually holds between the antecedent question and the *Question Under Discussion* (QUD) pertaining to the consequent, thus for (18) it is between the two questions '*who comes?*' and '*who will John invite for dinner?*'. But it doesn't solve the whole problem. In both Rawlins' characterization and the definition (17), the orthogonality between two issues requires that the resolution of either one does not *partially* resolve the other. Now imagine a scenario where it is common knowledge that John only invites people for dinner if they come. (18) can still be felicitously uttered, but now a resolution to the QUD of the consequent, say, John will invite *Bill* for dinner, would provide at least a partial answer to the antecedent question, namely, *Bill* comes. The orthogonality is again sabotaged. Therefore, instead of resorting to QUD, I propose to relocate the orthogonality in between the antecedent and the *propositional content* of the unconditional. This modification pinpoints the orthogonality conveyed by ∀-FC constructions, while preserving the definition (17): recall that Fig. (1a) depicts the antecedent identity question raised in (3b), while Fig. (1b) illustrates its propositional content—and clearly the latter 'cuts across' the former. Moreover, as has already been noted in the beginning of the section that the semantic denotations of unconditionals *without* binding (thus unlike 18) is equivalent to its consequent, the new proposal still derives the orthogonality for cases like (4).

Finally, it is worth noting that at least one of the two issues standing in an orthogonal relation has to be *inquisitive*—otherwise, (17) would trivially characterize the logical independence between two non-inquisitive propositions. In unconditionals, such obligatory inquisitiveness is imposed on the antecedent, and as we can see from (13), corresponds directly to the plurality requirement of dou_Q. This observation is crucial in revealing the connection between distributivity and free choice/unconditionals—as I will argue in §3.2, the plurality requirement of the distributive use of *dou* can also be construed as certain (sub-level) inquisitiveness, or *variation*.

3.2 Orthogonality in Distributivity?

We will base our discussion in a basic setting of Plural Predicate Logic (PPL, Champollion et al., 2017), which was inspired by Dynamic Plural Logic (van den Berg et al., 1996). PPL differs from Predicate Logic in that its formulae are evaluated relative to *sets of assignments*, which I refer to as *assignment matrices*, instead of single assignments. As a result, PPL provides formal mechanisms capable of encode fine-grained *plurality* information such as quantificational dependency (see, e.g. Brasoveanu, 2008; Henderson, 2014). Illustrations of an assignment matrix G consisting of three assignment functions g_1, g_2, g_3 assigning values to a variable u are shown in Fig. (3).

G	...	u	...
g_1	...	$a \oplus b$	...
g_2	...	$a \oplus b$	...
g_3	...	$a \oplus b$	...

(a) assignment-level plural, no variation, **dou*

G	...	u	...
g_1	...	$a \oplus b$	...
g_2	...	$b \oplus c$	...
g_3	...	$a \oplus c$	...

(b) assignment-level plural, with variation, ✓*dou*

G	...	u	...
g_1	...	a	...
g_2	...	b	...
g_3	...	c	...

(c) assignment-level singular, variation, ✓*dou*

Figure 3: Plurality requirement of the distributor use of *dou*

When translating natural language utterances to PPL formulae, (plural) DP such as '*they*' can pick up the variable u and denote the plurality sum of the values assigned by the functions in the assignment matrix, thus $[\![they_u]\!]^G = a \oplus b \oplus c$. However, the evaluation against a distributive predicate, such as '*come*', still goes into the assignment level and checks if the individual assigned by *each* function satisfies the predicate. Therefore, $[\![they_u\ come]\!]^G = \forall g \in G : Come(g(u))$, i.e. a, b and c *each* comes. Finally, given the distributivity effect of *dou*, we assume that it forces the assignment-level evaluation to any predicate it modifies, even for a collective predicate such as '*be friends*' in (2b)[5].

Now back to plurality requirement. In §2.1, it is described as presupposing non-singleton covers, even though *dou* generally allows non-atomic elements in them. Transferring the description into a PPL setting, plurality boils down to a requirement of **variations** among different assignment functions within a matrix, as demonstrated by the contrast between Fig. (3a) and Fig. (3b). When applied to the sentence '$they_u$ **dou** *be friends*', the matrix in Fig. (3a) suffers a failure even if a and b indeed are friends, whereas the one Fig. (3b) successfully yields the interpretation that 'a, b, c *are mutual friends*'.

The requirement of *variation* pertaining to distributivity effect is not unfamiliar. It is brought out, for instance, by numeral reduplications in Telugu (Balusu, 2006), verbal pluractionals in Kaqchikel (Henderson, 2014) and dependent indefinites (Farkas, 1997). However, in

[5]However, distributive and collective predicates do not correspond one-to-one to assignment-level and matrix-level evaluations, since there are different types of collective predicates (Winter, 2002). For instance, *be friends* is a typical assignment-level collective predicates, as opposed to matrix-level collective predicates such as '*gather*'. In fact, *dou* can modify both types, but the limited space would not allow further discussions. For more details, I refer to Dotlačil and Roelofsen (2019) and Zhao (2019) ch.3,4.

the light of §3.1, we can further imagine an orthogonality-like characterization of distributivity effect—the orthogonality lies between the *identity* of each individual in the quantificational domain (note the similar illustration between identity questions in Fig. (1a) and Fig. (3)), and the fact that they *all* satisfy the remnant predicate. In fact, it is possible that the Cantonese distributivity marker '*saai*' overtly realizes such effect, by imposing an additional *independent* interpretation over distributivity (Law, 2019).

4 Outlook

The endeavor towards a uniform analysis of the distributive and free choice uses of *dou* is not new (in particular, see Xiang, 2019). However, the paper provides a new perspective that reveals an underlying feature shared between them, namely to convey **orthogonality**, and argues the **plurality requirement** of *dou* guarantees its non-triviality.

I will end this paper with a few more puzzles in the family. First, an anonymous reviewer expressed worries on the **licensing** problems of ∀-FC containing dou_Q. In §1.2, only two kinds of associates were introduced: the disjunction '*haishi*' that is commonly used in alternative questions in (3a), and *wh*-phrases in in (3b). However, dou_Q is also able to combine with the polarity item '*renhe*' (any) and declarative disjunctions with '*huozhe*' (or), as shown in (19) and (20). However, compared to (3), they are much worse in episodic context. The analysis given in Xiang (2019) captures the infelicity in episodic context, but also predicts infelicity under necessity modals, as opposed to what empirical data shows (19b). A solution to this problem has to be left for future work, but to explore the interaction between orthogonality/plurality and modal context seems to be a promising start.

(19) a. [Ren-he ren] dou keyi lai.
Any person **dou** may come.
'Anyone may come.'

b. [Ren-he ren] dou bixu canjia.
Any person **dou** must participate.
'Anyone must participate.'

(20) [Yuehan huozhe Mali] dou keyi jiao jichu hanyu.
John or Mary **dou** may teach intro Chinese.
'Both John and Mary may teach intro Chinese.' (Xiang, 2019)

Second, in this paper I left out yet another major use of *dou*, in which it associates with focused items and creates *even*-like readings (21).

(21) (Lian) $[\text{YUEHAN}]_F$ dou lai-le.
(LIAN) JOHN **dou** come-LE.
'Even John came.'

An analysis using the same schema can be found in Zhao (2019). But a yet more interesting question to ask is whether the semantics of these constructions can also be characterized using orthogonality. I leave this also to future work.

Finally, though I adhered to Lin's schema of treating *dou* as a distributor, it remains to be seen whether it is indeed one. An empirical argument against it is that *dou* co-occurs with real distributive quantifiers such as '*meige*' (every). Zhao (2019) proposed an analysis that treats *dou* as imposing *only* the plurality requirement, and instead of a presupposition, I treated it as a *postsupposition* (cf. Brasoveanu, 2008; Henderson, 2014; Champollion, 2015). This alternative approach accommodates the co-occurrence of *dou* with other distributive quantifiers, while capturing most of the other data. However, more empirical investigation needs to be done to finally settle this issue.

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