***Dou* and homogeneity removal**

A new perspective to the co-occurrence puzzle

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Plural definites are known to exhibit *homogeneity* and *non-maximality* effect. The two phenomena are reported to appear and disappear together; universal quantifiers (UQs) like *every/all* can remove both (Križ 2015). The nature of Mandarin UQs has long been contested since they canonically co-occur with *dou*, which also seems to also exert UQ force. In this paper, I will present novel data that *dou* has the *true* UQ power due to its ability to remove homogeneity. Building on the view that homogeneity results from pluralization (since Schwarzschild 1993), I treat *dou* as a universal pluralization operator ∀-PL (Bar-Lev 2021); homogeneity removal is thus a by-product of agreement between UQ and ∀-PL.

1. Introduction

Plural definite descriptions (PDs) cross-linguistically are known to exhibit *homogeneity*: in out-of-the-blue contexts, we can infer from (1a) that all the kids smiled while from (1b) that none of kids smiled. This puzzling fact that PDs seem to have different interpretation in different linguistic contexts is called homogeneity.

(1) Homogeneity

a. The kids smiled.

(i) ≈ All of the kids smiled. (∀)

(ii) ≉ Some of the kids smiled. (∃)

b. The kids did not smile.

(i) ≈ None of the kids smiled. (¬∃)

(ii) ≉ Not all the kids smiled. (¬∀)

Note that PDs' interpretation in (1a) is only quasi-universal rather than *truly* universal because in certain contexts, sentences containing PDs can have *non-maximal* readings. In a context like

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(2a), the sentence *the kids smiled* is judged true even if a few kids did not smile (see Brisson 1998, Lasersohn 1999, Malamud 2012, Križ 2015, 2016).

(2) Non-maximality
   a. *Context: John hired a professional costumed character for his son's birthday party. Someone is wondering whether the kids are entertained and asks John. John replies:*
   b. The kids smiled.

In a context like (3a) where the distinction between all and not all of the kids smiled is crucial, the sentence containing PD only has a maximal reading.

(3) a. *Context: John is willing to give the party entertainer a 5-star review only if they made all the kids smile. The entertainer says:*
   b. The kids smiled.

The non-accidental link between homogeneity and non-maximality has been emphasized in the literature (Löbner 2000, Malamud 2012, Križ 2015, 2016, a.o.) based on the observation that the two phenomena seem to appear/disappear together: universal quantifiers (UQs) like *every/all* can remove both. Sentence (4a) can not be uttered in the non-maximal context in (2a); homogeneity is removed in (4b) in the sense that under negation the "not all" reading becomes available again.

(4) Removal of homogeneity and non-maximality
   a. Every kid/All the kids smiled.
      (i) $\rightsquigarrow$ The kids all smiled with no exception. ($\forall$)
      (ii) $\not\rightsquigarrow$ Some but not all kids smiled. ($\neg\forall$)
   b. Every kid/All the kids did not smile.
      (i) $\rightsquigarrow$ Not all of the kids smiled. ($\neg\forall$)
      (ii) $\not\rightsquigarrow$ None of the kids smiled. ($\neg\exists$)

This paper intends to explore some of the various issues brought up by these facts above. If homogeneity and non-maximality are truly two sides of the same coin, then expressions that give rise to non-maximality must also give rise to homogeneity, and *vice versa*. However, the behaviors of expressions like *Mary and John* and *the three kids* indicate otherwise: they give rise to homogeneity but do not allow non-maximal interpretations (see Bar-Lev 2021).

(5) Only maximal readings:
   a. Mary and John smiled.
      ≈ *Both* Mary and John smiled.
   b. The three kids smiled.
      ≈ *All* of the three kids smiled.

(6) Homogeneity arises:
   a. Mary and John did not smile.
      ≈ Neither Mary nor John smiled.
   b. The three kids did not smile.
      ≈ None of the three kids smiled.

The fact that non-maximality disappears while homogeneity persists calls for a fundamental

reconsideration of the origin of homogeneity and how exactly it is removed by UQs. In this work, I will show that Mandarin provides fertile grounds for probing which view of homogeneity removal should be entertained. Unlike in English, Mandarin UQs canonically co-occur with *dou*, a morpheme whose semantics is still open to discussion.

The roadmap is as follows: as background, section 2 details the puzzling licensing conditions of Mandarin UQs and the limits of previous approaches. Then in section 3, I will present novel data showing that a) *dou*, not Mandarin UQs, removes homogeneity; b) not all Mandarin UQs remove non-maximality. In section 4, I will explain the relevant Mandarin data based on the assumption that homogeneity is not attributed to PDs but to the workings of the pluralization operator which applies to VP predicates (following Schwarzschild 1993, Križ 2015). I will import the denotation of two types of pluralization operators (∃-PL and ∀-PL) from Bar-Lev (2021). The gist of the proposal is that whatever removes homogeneity is not to be hard-wired into the semantics of UQs; homogeneity removal is instead a side effect of agreement between UQ and ∀-PL, which is subject to cross-linguistic variation. Section 5 considers some remaining issues and concludes.

2. UQs in Mandarin

UQs seem to be omnipresent in natural languages. However, there has not been a consensus on their representations in Mandarin. Mandarin *mei* and *suoyou* have been considered as strong contenders given their power to exert *maximality*. Traditionally translated as 'every', *mei* selects for a *numeral + classifier + noun* complex (henceforth referred to as *NumP*) as in (7a), while *suoyou*, translated as 'all', attaches directly to bare nouns (with an optional *de-* linker) as in (7b).

(7) a. mei yi *(ge) haizi
MEI one CLF kid
'every kid'

b. suoyou (*yi ge) (de) haizi
SUOYOU one CLF DE kid
'all (of the) kids'

2.1. The puzzles of dou

But the UQ nature of *mei* and *suoyou* has long been contested (since Lin 1998) by the "co-occurrence" puzzle as exemplified in (8). *mei* and *suoyou* subjects are canonically licensed by another morpheme *dou* within a clause.[1] In a sentence containing *mei-* and *suoyou*-subjects, *dou* is in a position following the *mei*/*suoyou*-subjects and preceding the verb and its aspect markers. So all else being equal, the word order of a clause with *dou* would be [*mei*/*suoyou* Subject – DOU – Verb].

[1] A reviewer pointed out that *mei* and *suoyou* can also appear without *dou*. I have no intention to make a strong claim that *mei* must be accompanied by *dou*. *Mei-dou* "co-occurrence" is far from being a strict constraint due to the existence of some, if not many, exceptions. It is just the case that one of them (see next page) is centered in this paper.

(8) a. mei-(yi)-ge haizi *(**dou**) qu-le gongyuan.
MEI-one-CLF kid DOU go-PRF park
'Every kid went to the park.'
b. suoyou-(de) haizi *(**dou**) qu-le gongyuan.
SUOYOU-DE kid DOU go-PRF park
'All (of the) kids went to the park.'

Such observations seem to suggest that *mei* and *suoyou* lack proper UQ force and thus require assistance from *dou*. But here is an exception to *mei-dou* co-occurrence: with the presence of a NumP object in the VP as in (9), *dou*'s presence becomes optional (first observed by Huang 1996). Unlike *mei*, *suoyou* (≈'all') behaves differently in the sense that in subject positions it requires *dou*'s presence, regardless of what is in the object position as shown by (10).

(9) mei-(yi)-ge haizi (dou) hua-le **yi-fu-hua**.
every-one-CLF kid DOU draw-PRF one-CLF-picture
'Every kid drew one picture.'

(10) suoyou-(de) haizi *(dou) hua-le **yi-fu-hua**.
SUOYOU-DE kid DOU draw-PRF one-CLF-picture
'All (of the) kids (each) drew one picture.'

The co-occurrence data reported above are further complicated by what is known as the *subject/object asymmetry*: *mei* and *suoyou* can appear in object positions without *dou* and still manage to express true UQ force on their own.[2] *mei* and *suoyou* in (11) blocks non-maximality – the sentence is judged true iff the kids, without any exception, are liked by John.

(11) yuehan xihuan mei-(yi)-ge/suyou haizi.
John like MEI-one-CLF/SUOYOU kids
'John likes every kid/ all (of the) kids.'

2.2. Previous approaches

Previous solutions to these puzzles differ in terms of technical details but have been along similar lines: they try to strip away either *mei/suoyou*'s or *dou*'s quantificational force. For example, Lin (1998) treats *mei* as picking out the maximal plural individual in the domain provided by its sister. In a context where $[\![\text{kid}]\!] = \{a, b, c, d\}$, $[\![[mei\ [1\ \text{CLF kid}]]]\!] = \bigoplus(\{x|\mathbf{kid}(x) \wedge |x| = 1\}) = \{a, b, c, d\}$. Under such an approach, *mei*+NumP is treated on a par with English PDs (as non-quantificational of type *e*); *dou*, analyzed a distributive operator, supplies the UQ force. Such an analysis, although pointing out a promising direction for solving the puzzles, failed to account for the exceptional cases where *mei* can appear without *dou* in (9), repeated below in (12).

(12) a. mei-ge haizi hua-le yi-fu-hua.
MEI-CLF kid draw-PRF one-CLF-picture

[2] A very puzzling fact is that objects *mei*, in contrast to in subject positions, can occur more freely without *dou*. For dou to be inserted in *mei*-object sentences, *mei*-object must moved to somewhere that precedes *dou*, either to a sentence initial position or a position following the subject. This is in fact one of the puzzle of *dou* — once *dou* is merged, it seems to be associated with movements. A detailed discussion of these cases with *mei*-objects is out of the scope of this paper.

'Every kid drew one picture.'

b. mei-ge haizi (dou) hua-le yi-fu-hua.
MEI-CLF kid DOU draw-PRF one-CLF-picture
'Every kid drew one picture.'

At first glance, the minimal pair (12a) and (12b) with/without *dou* are semantically equivalent. This observation motivates recent analyses of *dou* as truth-conditionally vacuous (e.g. Liu 2021). According to Liu, *dou*, as a focus-sensitive particle, carries the presupposition that the prejacent clause is the strongest (in terms of entailment) among all alternatives. *mei* is treated on a par with *every* as a true UQ[3]. When *mei* and *dou* co-occur, *dou*'s presupposition is always satisfied since the prejacent containing *mei* is always the strongest among all alternatives (see more details in Liu 2021). *mei-dou* co-occurrence is thus an instance of obligatory presupposition regulated by *Maximize Presupposition* (MP, Heim 1991).

Although Liu makes inadequate predictions regarding *dou*'s semantic contribution (which I will elaborate on in section 3), this account is still of considerable reference value as it brings forth a more nuanced characterization of *dou*'s presence/absence. The contrast between the (13a) and (13b) (an example from Liu 2021) suggests that *dou*'s occurrence reflects the current *Question Under Discussion* (QUD as in Roberts 2012).

(13) *Context: At a secondhand bookstore. . .*

a. *The bookstore owner: "Our store is having a big sale,*

mei-ben shu 10 yuan.
MEI-CLF book 10 yuan

'Every book is TEN YUAN." **QUD: How much is every book?**

b. *John: 'This book looks brand-new and super expensive. Is it also 10 bucks?' The owner replies:*

mei-ben shu dou 10 yuan.
MEI-CLF book DOU 10 yuan

'EVERY book is 10 yuan.' **QUD: Is every book 10 yuan?**

Utilizing the idea that QUDs can shape the set of alternatives *Alt* with respect to contextual relevancy, Liu makes the following predictions: in the context where (13a) is uttered, the focus was on the price of every book '10 yuan'; the QUD is therefore regarding the price of every book, under the natural assumption that every book costs the same in this sale. In such a context, the sub-domain alternatives are intuitively not relevant to the QUD and are thus pruned. The result is that *Alt* becomes a singleton set containing only the prejacent. Assuming that *dou* behaves similarly to other focus-sensitive operators, the principle of *non-vacuity* (Xiang 2020) blocks its occurrence.[4]

[3] An important ingredient of Liu (2021)'s treatment of *mei* as a true UQ is that UQs obligatorily trigger sub-domain alternatives (Chierchia 2013, Zeijlstra 2017). This ensures that entailment relations hold among the corresponding propositional alternatives of *mei*-sentences.

[4] Non-vacuity is motivated by felicity conditions of the overt *only*. As exemplified in (i), the answer (ib) is infelicitous because no alternative is stronger than the prejacent and thus none of them is excludable, leaving the overt exhaustifier *only* semantically vacuous. See more discussion on the ban on vacuous exhaustifications in Xiang (2014a) and Fox & Spector (2018).

But in a context as in (13b), the QUD is about whether a universal statement is true, i.e. whether EVERY book costs 10 yuan. According to Liu, the evaluation of the truth/falsity of a universal statement requires checking the truth/falsity of each individual instantiation. In this case, sub-domain alternatives are contextually relevant and thus remain in *Alt*. Since *dou* carries an extra presupposition that the prejacent must be the strongest, MP blocks the *dou*-less sentence.

Liu's pragmatic account provides convincing evidence that a purely grammatical view, without any admixture, is inadequate to capture the complexity of obligatory *dou*. However, such an account imposes the following undesired licensing constraint on *dou*: in contexts like (13a) where the QUD is not about a universal statement, *dou* is predicted to be absent due to non-vacuity. Such prediction does not align with native speakers' intuitions — my informants reported that both versions of the sentence with/without *dou* can be uttered in context (13a). This discrepancy is presented in Table 1.

	Liu (2021)	**Mandarin speakers**
dou in context (13a)	*absent*	*optional*
dou in context (13b)	*obligatory*	*obligatory*

Table 1. Liu (2021)'s predictions comparing to native speakers' judgments of (13)

To take stock of the discussion so far: Both the grammatical (Lin 1998) and the pragmatic account (Liu 2021) suffers from several issues which make them inadequate to account for *dou*'s obligatoriness/optionality. In the following section, I will provide evidence that homogeneity and non-maximality, as two aspects of the phenomenon overlooked by the previous literature, might shed light on the puzzles at hand.

3. Revisiting the role of dou and mei

In this section, I will show that the puzzling minimal pair of *mei*-sentences with/without *dou* provides fertile grounds for testing the removal of homogeneity and non-maximality. Contrary to what is traditionally accepted in the literature, I will provide evidence that a) *dou*, not *mei*, removes non-maximality; b) *dou*, not *mei/suoyou*, removes homogeneity;

3.1. Dou, not mei, blocks non-maximality

Recall that the use of *mei/suoyou* seems to always enforce maximality as shown by the data in section 2.1. This motivates the "sum operator" analysis where *mei/suoyou* picks out the maximal plural individual in the domain by their sister. For example, $[\![[mei\ [1\ \textsc{clf}\ \text{kid}]]]\!] = \bigoplus(\{x|\mathbf{kid}(x)\wedge|x| = 1\})$. This semantics is, however, challenged by the cases where *mei* combines with a NumP with $|\textsc{num}| > 1$ (Sun 2017). In the scenario below, instructions (14a) and (14b) describe different intended outcomes.

(i) A: Who made the kids laugh?
   a. B: Only ANN, (not Bea).
   b. B: # Only BOTH (Ann and Bea).

(14) *Scenario: The teacher is giving instructions to the 4 kids a,b,c,d in an art class:*

a. **mei-liang-ge** haizi hua yi-fu-hua!
MEI-two-CLF kid draw one-CLF-picture
'Groups of 2 kids draw 1 picture!'

b. **mei-liang-ge** haizi **dou** hua yi-fu-hua!
MEI-two-CLF kid DOU draw one-CLF-picture
'Every conceivable pair of kids, draw 1 picture!'

(14a) would be made true iff any of the following three possibilities is true:

(15) a. $\{\{a,b\},\{c,d\}\}$ drew 1 picture
b. $\{\{a,c\},\{b,d\}\}$ drew 1 picture
c. $\{\{a,d\},\{c,b\}\}$ drew 1 picture

(14b) would be true iff

(16) $\{\{a,b\},\{c,d\},\{a,c\},\{b,d\},\{a,d\},\{c,b\}\}$ drew 1 picture.

The different interpretations above are not predicted by the "sum operator" analysis: [*mei* 2 CLF kid] in (14a) is not interpreted as $\bigoplus(\{X|\mathbf{kid}(X) \wedge |X| = 2\})$; it instead picks a contextually salient non-overlapping *cover* (Schwarzskid 1996) among the 3 possible covers. Note that when *dou* is inserted as in (14b), the "all conceivable pairs" reading becomes the only possible reading.

Cases like (14) call for serious reconsideration of *mei*'s ability to remove non-maximality. It seems that the presence of *dou*, *de facto*, ensures the maximal reading. Such an issue has yet not received much attention because most of the previous studies only focus on the interpretation of [mei+1+CLF+N]. The minimal pair in (12), repeated below in (17), indeed appears to be semantically equivalent. Now the question is: how is *mei* by itself exerting maximality in (17a) but not in (14a)?

(17) a. mei-ge haizi hua-le yi-fu-hua.
MEI-CLF kid draw-PRF one-CLF-picture
'Every kid drew one picture.'

b. mei-ge haizi (dou) hua-le yi-fu-hua.
MEI-CLF kid DOU draw-PRF one-CLF-picture
'Every kid drew one picture.'

I want to point out one potential way to understand *mei*'s seemingly inconsistent behavior: *coverage* and *maximality* are two separate concepts. *mei* in (14a) only ensures a weaker reading where every kid belongs to a group of 2 kids that draw 1 picture; I call this reading the "cover reading". Only the co-occurrence of *mei* and *dou* in (14b) blocks non-maximality with respect to the domain of $[\![2\ \text{CLF}\ \text{kid}]\!]$ — (14b) has the truly "maximal reading" where every conceivable pair of kids should follow the teacher's instruction and draw 1 picture.

This also explains the seemingly maximal power of *mei* in (17a): $[\![1\ \text{CLF}\ \text{kid}]\!]$ imposes the requirement that each cell of the cover contains an atomic kid; therefore, there is one and only one way to partition the set $\{a,b,c,d\}$, namely $\{\{a\},\{b\},\{c\},\{d\}\}$. In such cases, the "cover reading" and the "maximal reading" are truth-conditionally equivalent. This, of course, brought us right back to the initial question — what is the role of *dou* in (17b) when its power to enforce maximality is trivial? I have proven in section 2.2 that Liu (2021)'s analysis is inadequate by

deeming *dou* as truth-conditionally vacuous; on top of this, it fails to predict the optionality of *dou*. In the next section, I will draw attention to the missing piece of the puzzle — the presence of *dou* is necessary for homogeneity removal.

3.2. Dou, not mei, removes homogeneity

Although *dou*'s ability to give rise to maximality has long been under the spotlight (Giannakidou & Cheng 2006, Xiang 2008, Cheng et al. 2013)[5], its connection to homogeneity is by far overlooked.

Similarly to English PDs, Mandarin bare plurals (which can have a definite interpretation) give rise to the homogeneity effect. They receive a quasi-universal interpretation that allows non-maximality (depending on the contexts, as discussed in section 1); but in downward-entailing contexts,[6] they are interpreted existentially, resulting in noticeably stronger truth-conditions.

(18) a. haizi-men xiao-le.
kid-PL laugh-PRF
'The kids laughed.'
b. ≈ All/Almost all of the kids laughed. (∀)
c. ≉ Some of the kids laughed. (∃)

(19) a. *A asks B:*
haizi-men xiao-le ma?
kid-PL laugh-PRF SFP
'Did the kids laugh?'
b. *B replies:*
mei-you.
NEG-PRF
'No.'
(i) B's answer ≈ None/Nearly none of the kids laughed. (¬∃)

[5] Note that for these authors, the term maximality is used differently than in this work. For these maximality-based accounts of *dou*, the maximal interpretation stems from definiteness; the presence/absence of *dou* manifests the the definite vs. indefinite split in Mandarin. In this sense, *dou* is treated on a par with the definite determiner.

[6] Here I use questions with negative answer as diagnostics to avoid undesired complications introduced by two different forms of Mandarin negation *mei* vs. *bu*. They have been argued to take scope over and below aspect, respectively (see Xiang 2014b). Since the origin of the quasi-UQ force provided by Mandarin plurals is to be determined, the possibility that the strong reading "none of the kid laughed" could be derived from a lower scope negation should be entirely ruled out. This is due to the observation that homogeneity is not conditioned by scopal relations (Kriz et al. 2015). For example, the sentence below in (i) contains a bound variable which prevents the definite plural from taking wide scope, the only possible reading is still the "not any" reading.

(i) No boy found his presents.
The only reading: No boy found any of his presents.

One might wonder whether homogeneity is found in the domains of questions. Kriz et al. (2015) did note a parallel between the behavior of expressions containing definite plurals and embedded questions. One possible explanation is provided by Blok & Chark (2021): they showed the semi-lattice homomorphism between the question domain Q (with distributive predicates) and the domain of plural individuals.

(ii) B's answer $\not\rightsquigarrow$ Not all of the kids laughed. ($\neg\forall$)

As discussed in the previous section, evidence shows that *dou*, not *mei*, blocks non-maximality. This is also illustrated by (20). Notably, homogeneity also disappears when *dou* is inserted. In negative contexts, the quasi-universal interpretation of the bare plural *haizi-men* 'kids' in (21) is revived by the occurrence of *dou*.

(20) haizi-men *dou* xiao-le.
kid-PL DOU laugh-PRF
'The kids all laughed.'
$\rightsquigarrow$ The kids all laughed with no exception.

(21) a. *A asks B:*

haizi-men dou xiao-le ma?
kid-PL DOU laugh-PRF SFP

'Did kids all laugh?'

b. *B replies:*

mei-you.
NEG-PRF

'No.'

(i) B's answer $\rightsquigarrow$ Not all of the kids laughed. ($\neg\forall$)
(ii) B's answer $\not\rightsquigarrow$ None of the kids laughed. ($\neg\exists$)

Now returning to *mei*-sentences: if *mei* only ensures *coverage* but exerts no maximality, then homogeneity should also survive with the presence of *mei*. This is indeed the case in Mandarin, illustrated below in (22):

(22) a. *A asks B:*

mei-liang-ge haizi hua-le yi-fu-hua ma?
MEI-TWO-CLF kid draw-PRF one-CLF-picture SFP

'Is it the case that groups of 2 kids each draw 1 picture?'

b. *B replies:*

bu-shi.
NEG-FOC

'No. (In fact, groups of 2 kids each drew 2 pictures.)'

(i) B's answer $\rightsquigarrow$ No groups of 2 kids drew 1 picture. ($\neg\exists$)
(ii) B's answer $\not\rightsquigarrow$ Not all groups of 2 kids drew 1 picture. ($\neg\forall$)

But when *dou* is inserted in *mei*-sentences as in (23), from a negative answer we can only infer that not all groups of 2 kids drew 1 picture; homogeneity is removed.

(23) a. *A asks B*:

mei-liang-ge haizi **dou** hua yi-fu-hua ma?
MEI-TWO-CLF kid DOU draw one-CLF-picture SFP

'Is it the case that every conceivable pair of kids drew 1 picture?'

b. B replies:

bu-shi.
NEG-FOC

'No. (Ann and Bea left early to have ice cream.)'
(i) B's answer ⇝ Not all groups of 2 kids drew 1 picture. ($\neg\forall$)
(ii) B's answer ↛ No groups of 2 kids drew 1 picture. ($\neg\exists$)

The diagnostic above points us to a novel way to think about *dou*: it plays an indispensable role in homogeneity removal due to its power to enforce maximality by introducing the UQ force. The fact that *dou*, not *mei*, removes homogeneity provides cross-linguistic support for the following view: whatever removes homogeneity is not to be hard-wired into the semantics of UQs; instead, homogeneity arises/disappears under the working of how different types of DP subjects can license different types of pluralization operators (Bar-Lev 2021). In the next section, I will spell out my analysis of *dou* as a universal pluralization operator in detail.

4. Obligatory dou as overt pluralization operator

4.1. Basic assumptions: homogeneity and the basic weak semantics of PDs

My proposal has the following ingredients. First, following Križ (2015), I assume the PDs like *the kids* have the standard denotation $\bigoplus(\{x|\mathbf{kid}(x)\})$. Their existential interpretation comes from an existential pluralization operator ∃-PL at the LF (Bar-Lev 2021). This deviates from the classical approaches where pluralization is realized by the DIST operator (e.g. Link 1987, 1996). The reason why I adopt Bar-Lev (2021)'s approach[7] is as follows: the insertion of a universal DIST operator will lead to serious problems when PDs in negative contexts — the UQ force introduced by DIST operator is unable to be manipulated; the attested "not all" reading would arise. The interpretation of *mei*-sentences constitutes another counterargument: as observed in (14), despite only having a distributive reading, *mei* + *2* CLF *kid* is in fact interpreted existentially, denoting a possible cover of kids. To some extent, Bar-Lev (2021)'s proposal is parallel to Schwarzschild (1993)'s idea that to combine with plural DPs, their sisters must also be pluralized. So a simple sentence like *The kids smiled* has the LF in (24a). With the lexical entry defined in (24b), the sentence has the weak reading that at least one of the kids smiled.

(24) a. [The kids] [∃-PL smiled] [8]
b. $[\![\exists\text{-PL}]\!] = \lambda P_{et}.\lambda x_e.\exists y \sqsubseteq x[P(y) = 1]$

This yields the desired "$\neg\exists$" reading of sentences containing PDs in negative contexts. As for the positive cases, Bar-Lev (2021) appeals to an implicature account where the basic existential meaning is strengthened to a universal one.[9]

(25) LF with exhaustification:
[EXH [[The kids] [∃-PL smiled]]]

[7] See more evidence for the presence of Bar-Lev (2021)'s ∃-PL from Dynamic Semantics discussed in Chierchia (2022).

[8] I left out the domain variable restricting the quantifier domain and the world variable for the sake of simplicity.

[9] I will not elaborate on the details of how the system of implicature calculation works since it is beyond the scope of this paper. See details in Bar-Lev & Fox (2017) and Bar-Lev (2021).

The second ingredient of my proposal concerns how homogeneity is removed. By adopting the idea that PDs have the basic weak meaning, the job of homogeneity removers like *all*, *every* or *dou*, intuitively speaking, is to switch the existential meaning of plural DPs into a universal one. One potential way, which is briefly sketched in Bar-Lev (2021), is to treat homogeneity removers on a par with overt exhaustifiers. Such an approach is not very appealing to account for *mei*-sentences with *dou*. As shown by (17), repeated below in (26), *dou* is semantically trivial as (26a) and (26b) are truth-conditionally equivalent. In such cases, *dou* gives rise to vacuous exhaustifications, which would lead to violation of the non-vacuity condition (Xiang 2014a, 2020, Fox & Spector 2018).

(26) a. mei-ge haizi hua-le yi-fu-hua.
MEI-CLF kid draw-PRF one-CLF-picture
'Every kid drew one picture.'
b. mei-ge haizi (dou) hua-le yi-fu-hua.
MEI-CLF kid DOU draw-PRF one-CLF-picture
'Every kid drew one picture.'

I therefore entertain a different approach brought up in Bar-Lev (2021), which at the time suffers from the problem of being purely stipulative. This analysis hinges on the idea that different types of plural DPs can license different types of pluralization operators; the licensing pattern is subject to cross-linguistic variation. Based on the behaviors of English plural DPs, Bar-Lev (2021) assumes that English non-quantificational DPs like *the kids* require a ∃-PL while DPs with UQ force require the universal counterpart ∀-PL to be present at LF.

(27) a. [The kids] [∃-PL smiled]
b. [All the kids] [∀-PL smiled]

Building on this idea, I propose that Mandarin offers empirical support for such an assumption. *dou*, as an overt instantiation of the universal pluralization operator ∀-PL, defined in (28), is required to head the sisters of Mandarin plural DPs that exert maximality, like *suoyou* DPs; other plural DPs, including *mei* DPs, without *dou* occurring overtly, a covert ∃-PL is present by default. The licit and illicit LFs are illustrated below:

(28) $[\![\text{DOU}]\!] = \lambda P_{et}.\lambda x_e.\forall y \sqsubseteq x[P(y) = 1]$

(29) a. ✓[kids] [DOU smiled]
b. ✓[kids] [∃-PL smiled]
c. ✓[suoyou kids] [DOU smiled]
d. ✗[suoyou kids] [∃-PL smiled]
e. ✓[mei 2 kid] [DOU smiled]
f. ✓[mei 2 kid] [∃-PL smiled]

4.2. Explaining the mei-dou puzzles

With the above ingredients, *mei-dou* puzzles (at least part of them) can be explained. I assume that *mei* creates an ensemble of all minimal covers, defined in (30) and (31), of the domain provided by the NumP. I also assume plural individuals are *e*-type entities just like singular

individuals (Link 1983), so ⟦2 CLF kid⟧ denotes a property.

(30) **Minimal Cover** : X minimally covers Y $\stackrel{\text{def}}{=}$

a. *X* is a subset of *Y*.

$$X \subseteq Y$$

b. The sum of the *X*'s blocks (members) is equal to the sum of *Y*'s blocks.

$$\bigoplus X = \bigoplus Y$$

c. *X* does not contain the empty set ∅ .

d. *X*'s blocks do not overlap.

$$\forall Z, Z' \in X \wedge Z \neq Z' : Z \cap Z' = \varnothing$$

(31) ⟦*mei*[2 CLF child]⟧ = λC_{et}. C *minimally covers* ⟦ 2 CLF child⟧
defined only if such C exists

In the "picture drawing" scenario discussed above in (14) where there are 4 kids *a,b,c* and *d*, the desired meaning of both sentences with/without *mei* can be derived with the LF in (33a) and (34a) respectively.

(32) a. $[\![2 \text{ CLF kid}]\!] = \lambda X_e . \forall x \in X : \mathbf{kid}(x) \wedge |X| = 2 = \{a \oplus b, c \oplus d, a \oplus c, b \oplus d, a \oplus d, c \oplus b\}$

b. $[\![mei[\ 2 \text{ CLF kid}]]\!] = \{\{a \oplus b, c \oplus d\}, \{a \oplus c, b \oplus d\}, \{a \oplus d, c \oplus b\}\}$

(33) a. [mei 2 CLF kid] [∃-PL drew 1 CLF picture]

b. (33a) is true iff $\{a \oplus b, c \oplus d\} \vee \{a \oplus c, b \oplus d\} \vee \{a \oplus d, c \oplus b\}$ drew 1 picture.

(34) a. [mei 2 CLF kid] [DOU drew 1 CLF picture]

b. (34a) is true iff $\{a \oplus b, c \oplus d\} \wedge \{a \oplus c, b \oplus d\} \wedge \{a \oplus d, c \oplus b\}$ drew 1 picture.

For the cases involving [mei+1 CLF N] where *dou*'s semantic contribution is trivial, our current grammatical view correctly predicts that *dou*'s presence is obligatory when the QUD is about the universal statement by blocking the otherwise present ∃-PL; as a result, homogeneity is removed since UQ force supplied by *dou* stays intact under negation, giving rise to the desired "not all" reading. This aligns with native speakers' general intuitions that expressing the "not all" meaning without *dou* is almost impossible in Mandarin.[10]

5. Conclusion and remaining issues

The presence/absence of *dou* poses a special problem for the nature of UQ force in Mandarin. Evidence that shows *dou*, not *mei*, is responsible for removing homogeneity and non-maximality helps us to further pinpoint the origin the UQ force in Mandarin: the supplier of the UQ force that can remove both homogeneity and non-maximality seems to reside in the process of pluralization.

Further work is still needed for a few remaining issues. First, the subject/object asymmetry remains unexplained: how come only *mei*-subjects, but not *mei*-objects, require the presence of *dou*? Another issue left behind in this work is why NumPs in the object position can license

[10] Another way to express "not all" in Mandarin requires the help of *quan*, a morpheme that resembles *dou* in many ways. A discussion of their nuanced differences will be left for another occasion.

optional *dou* in *mei*-sentences. One potential way to approach these two issues is to assume the interpretation of *mei* DPs varies depending on their syntactic positions, which has been entertained in the literature on how pluralization is carried out (Haslinger & Schmitt 2018, Schmitt 2019, Chatain 2022). It remains to be seen how this idea can be implemented to have proper explanatory value.

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Abbreviations

UQ	universal quantifier	CLF	classifier
PD	plural definite description	MP	maximize presupposition
PRF	perfect	DIST	distributivity operator
NUM	numeral	EXH	exhaustifier
QUD	question under discussion		

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