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On the Universal Construal of Mandarin *any*[*]

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Abstract Mandarin polarity-sensitive item *rènhé*, just like English *any*, is ungrammatical under a necessity modal; nevertheless, this may be ameliorated by the presence of the quantificational adverb *dou*, with the *rènhé*-DP carrying a universal construal. Crucially, the presence of *dou* alone is not sufficient to render *rènhé* grammatical. We suggest that the distribution of Mandarin *rènhé* in a modal environment is best captured by the two-layered approach by Crnič (2019a,b, 2022), according to which i) the license of *any* is subject to Strawson downward entailment, and ii) exhaustification merely plays a supplementary role by creating an environment hospitable to *any*. Along with these lines, we suggest that because of the universal force *dou* introduces, the scope of a necessity modal may be turned SDE and hence *rènhé* may be rescued in this environment.

Keywords: Mandarin, *any*, polarity-sensitive item, exhaustification, modality

1 Introduction

The Mandarin polairty-sensitive item *rènhé* (see (1)) has a similar distribution to that of English *any*; just lika *any* (see (2); see Dayal 1998, 2013; Chierchia 2013 and others), *rènhé* is grammatical in the scope of a possibility modal but not in that of a necessity one (see (3a-b) and (4a-b)[1]. Nonetheless, the ungrammaticality of Mandarin *rènhé* under a necessity modal may be ameliorated by the presence of the quantificational adverb *dou*, as shown in (3c) and (4c). Crucially, *rènhé* together with the presence of *dou*, in these examples, gives rise to a universal reading: (3c) says that you are required to discuss with every professor, and (4c) says that you are required to borrow every book.

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1 Throughout this paper, we gloss the PSI *rènhé* and the quantificational adverb *dou* as RN and DOU respectively.

(1) Zhāngsān *(méiyǒu) gēn rènhé jiàoshòu tǎolùn.
Zhangsan NEG with RN professor discuss
'Zhangsan didn't discuss with any professor.'

(2) a. You are allowed to talk to any professor.
b. * You are required to talk to any professor.

(3) a. nǐ **kěyǐ** gēn rènhé jiàoshòu tǎolùn.
2_{SG} be.allowed.to with RN professor discuss
'You are allowed to discuss with any professor.'
b. * nǐ **bìxū** gēn rènhé jiàoshòu tǎolùn.
2_{SG} be.required.to with RN professor discuss
'You are required to discuss with any professor.'
c. nǐ rènhé jiàoshòu dōu **bìxū** gēn tā tǎolùn. (∀-construal)
2_{SG} RN professor DOU be-required with 3_{SG} discuss
'You are required to discuss with every professor.'

(4) a. nǐ **kěyǐ** jiè rènhé shū lái dú.
2_{SG} be.allowed.to borrow RN book come read
'You are allowed to borrow any book to read.'
b. * nǐ **bìxū** jiè rènhé shū lái dú.
2_{SG} be.required.to borrow RN book come read
'You are required to borrow any book to read.'
c. nǐ rènhé shū dōu bìxū jiè lái dú. (∀-construal)
2_{SG} RN book DOU be.required.to borrow come read
'You are required to borrow every book to read.'

The quantificational adverb *dou* does introduce a universal quantificational force, as evidenced by the universal/distributive reading in (5), The presence of *dou* alone, however, is not sufficient to license *rènhé*, as shown in (6).

(5) Zhāngsān zhè-xiē shū dōu dú-lè.
Zhangsan these book DOU read-PERF
'Zhangsan read each of these books.'

(6) * Zhāngsān rènhé shū dōu dú-lè.
Zhangsan RN book DOU read-PERF

The ungrammaticality of (6) further shows that the amerlioration effect from *dou* in (3-4) cannot be seen as an instance of 'subtrigging' (see (7), where te ungrammaticality of *any* is ameliorated by the presence of relative clause that occurs with the host NP of *any*; see Dayal 1998; Chierchia 2013; and others).

(7) a. * John ate any cookies.
b. John ate any cookies Mary bought yesterday.

In this paper, we aim to provide an account for Mandarin *rènhé* in modal environments (e.g., (3a-b) and (4a-b) and the rescue effect from *dou* (see (3c) and (4c)). We show that the distribution of Mandarin *rènhé* shown in (3-4) provides a support for the two-layered approach to the license of *any* in Crnič 2019a,b, 2022. In Crnič's proposal, a PSI like *any* is only grammatical in a Strawson Downward-Entailing (henceforth, SDE) environment (cf. von Fintel 1999); while an environment where *any* occurs may be turned SDE as exhaustification applies, exhaustification itself does not necessarily play a decisive role in the grammaticality of *any*. In our analysis, we show that this is indeed the case for Mandarin *rènhé*: as predicted by Crnič's approach, *rènhé*, just like *any*, is ungrammatical in the scope of a necessity modal because this enivronment, unlike that of a possibilty modal, is not SDE with or without the application of exhaustification. On the other hand, with the presence of *dou*, exhaustification renders the scope of a necessity modal SDE and hence creates an envrionment hospitabe for *rènhé*.

2 Previous wisdoms

The contrast between the possibilty and necessity modals in licensing *any* has received attention in Dayal 1998 *et seq*; Chierchia 2013; and others[2]. Due to the space limit, we are unable to review the details of these existent accounts and can only point out that these accounts leave unexplained the amelioration effect from *dou* and the universal construal of the *rènhé*-DP, which is already shown in (3c) and (4c).

In the exhaustification-based approach to PSI licensing (e.g., Chierchia 2006, 2013; and others), the grammaticality of a PSI depends on the result of exhaustification introduced by a covert operator EXH akin to *only*. Along with these lines, a PSI like *any* triggers a set of alternatives based on its sub-domain and scalar alternatives (see (8)); EXH then serves to exclude those alternatives not entailed by its prejacent (i.e., its sister at LF; see (9)). *any* is grammatical if the result of exhaustification is consistent with the assertion of the prejacent of EXH.

(8) $[\![\textit{any/rènhé}_{\mathrm{D}}]\!]^{w}=\lambda P_{\langle e,\,t\rangle}.\ \lambda Q_{\langle e,\,t\rangle}.\ \exists x{\in}D[P(x){\wedge}Q(x)]$
ALT(*any/rènhé*)=
$\{\lambda P.\ \lambda Q.\ \exists x{\in}D'[P(x){\wedge}Q(x)]$: $D'{\subseteq}D$ and $D'{\cap}P{\neq}\varnothing\}\cup$ (Domain alternatives)
$\{\lambda P.\ \lambda Q.\ \forall x{\in}D'[P(x){\rightarrow}Q(x)]$: $D'{\subseteq}D$ and $D'{\cap}P{\neq}\varnothing\}$ (Scalar alternatives)

2 For instance, Dayal's (1998) Vagueness Condition, Dayal's (2013) Viability Condition, and Chierchia's (2013) Modal Containment and Wide-scope constraint for *any*

(9) [EXH [Mod . . . [*any*/*rènhé*$_{\text{D}}$ N] . . .]]

In some recent analyses, the Mandarin quantificational adverb *dou* has been seen as an overt incarnation of the operator EXH or as having a very similar contribiution to that of EXH (e.g., Xiang 2020)[3]. Along with such an idea, one might attempt to account for the amelioration effect from *dou* in (3c) and (4c) by parsing these examples as in (10). Putting aside the techinical details, we would like to point out some problems we have seen with the analyses along these lines: first, such attempts might fail to distinguish cases like (3b)/(4b) and (3c)/(4c); after all, it is unclear why exhaustification via EXH, but not via *dou*, fails to render *rènhé* grammatical in these examples if *dou* and EXH are assumed to carry the same or similar semantic contribution. Second, such attempts might run the risk of wrongly predicting that Mandarin *rènhé* patterns with German *irgendein* (see (11a)): German *irgendein* is grammatical in the scope of a necessity modal, and this is accounted for via the parse in (11b) (e.g., Chierchia 2013), which is parallel to (10). Nevertheless, unlike *rènhé*, *irgendein* gives rise to an existential rather than a universal construal in such an environment.

(10) [*dou* [Mod$_{\Box}$ . . . [*rènhé*$_{\text{D}}$ N]]]

(11) a. Du muss irgendein Buch aus der Leseliste lesen. (German; ∃)
You must irgend-a book from the reading.list read
'You are required to read a book, any book, from the reading list.'

b. [EXH [Mod . . . [*irgendein*$_{\text{D}}$ N] . . .]]

Departing from the exhaustification-based approach, Crnič (2019a) *et seq* proposes that the license of a PSI does not entirely depend on whether the exhaustification yields a consistent result. Instead, he suggests that for some PSIs such as English *any*, they are only grammatical in the SDE environment, and in some cases the application of exhaustification may turn an environment SDE and hence make it hospitable for these PSIs. Below we show how Crnič's proposal may capture the distribution of Mandarin *rènhé* in modal environments.

3 The two-layered approach to PSIs

Crnič (2019a,b, 2022) points out that *any* is grammatical only in an SDE environment: for a constituent to host *any*, this constituent has to support an inference from

3 The formalization of the semantic contribution of EXH is stripped away form the discussion here in order to make it brief. Nevertheless, detailed discussions on EXH and exhaustification will be provided in Section 3.

a set to its subsets on the grounds where the conclusion is defined (cf. von Fintel 1999; see The *Any* Condition in (12))[4].

(12) **The *Any* Condition** (Crnič 2019a,b): A DP headed by *any* is acceptable only if its domain is dominated by a constituent that is **S**trawson **D**ownward-**E**ntailing w.r.t to it.

a. For any $f_{\langle\sigma,\tau\rangle}$, $g_{\langle\sigma,\tau\rangle}$, f Strawson-entails ($\Rightarrow_s$) g iff for every x_σ s.t. g(x) is defined, f(x)$\Rightarrow$g(x);

b. A constituent C is SDE w.r.t. a sub-constituent X iff for every X' s.t. X'$\Rightarrow_s$X, it holds that C$\Rightarrow_s$C[X/X'] (where C[X/X'] is identical to C except that X' replaces X)

If a consitutent is not SDE *per se*, the application of exaustification (via the covert operator EXH) may turn this consitutent SDE and hence create an environment hospitable to *any*; as we will see below, the scope of a possibility modal is one of such cases.

The formalization of the semantic contribution of EXH, along with Bar-Lev & Fox 2020 and Crnič 2022, is given in (13): EXH excludes all the innocently excludable alternatives to the prejacent, namely those the conjucction of the negation of which are consistent with the prejacent (the IE alternatives; see (13a)); furthermore, it asserts that the prejacent together with those alternaives that are not innocently excludable are true (the II alternatives; see (13b)).

(13) Exhaustification: (Bar-Lev & Fox 2020; Crnič 2022; a.o.)
$[\![\text{EXH}]\!]^w = \lambda C_{\langle\langle s,t\rangle,t\rangle}.\ \lambda p_{\langle s,t\rangle}.\ \forall q \in \text{II}(p, C): q(w) \wedge \forall q \in \text{IE}(C, p): \neg q(w)$

a. **I**nnocently **E**xcludable alternatives:
IE(p, C)=$\bigcap${C'$\subseteq$C: C' is a maximal set of C such that {$\neg$q: q$\in$C'}$\bigcup${p}is consistent}

b. **I**nnocently **I**ncludable alternatives:
II(p, C)=$\bigcap${C"$\subseteq$C: C" is a maximal set of C such that {q': q'$\in$C"}$\cup${p}$\cup$IE(p, C) is consistent}}

Note that exhaustification does not necessarily render a constituent SDE and hence cannot guarantee the grammaticality of *any* in this environment; as we will see below, the scope of a necessity modal is still not SDE after exhaustification and hence cannot host *any*. In other words, in this two-layered approach, exhaustification merely plays an auxiliary role in determining the grammaticality of *any*.

Take (2a) for instance. The scope of a possibility modal does not suppot an SDE inference *per se*: that in some world w you talk to some professor in w does not entail

4 Crnič's (2022) notes that not all PSIs are subjetc to The *Any* Condition; one of such cases is German *irgendein*.

that in some world w you talk to some full professor in w. Nevertheless, it becomes SDE once exhaustification applies, and hence *any* is grammatical in this environment. The possibility statement (2a), along with Crnič's two-layered approach, may be parsed as in (14). With the lexical entry for *any* in (8), EXH operates on the set C of the alternatives to the prejacent in (15), where the IE alternatives are in red, and the II alternatives are in blue.

(14) LF of (2a)/(3a): [EXH-*C* [$_S$ ◇ [*any professor* [1 [*you talk to* t_1]]]]]

(15) Let D∩⟦*professor*⟧={a, b, c};
The alternative set C in (14)=: (IE; II)

$$\left\{\begin{array}{ccc} & \Diamond(a\vee b\vee c) & \\ \Diamond(a\vee b) & \Diamond(b\vee c) & \Diamond(a\vee c) \\ \Diamond a & \Diamond b & \Diamond c \end{array}\right\}\cup\left\{\begin{array}{ccc} & \Diamond(a\wedge b\wedge c) & \\ \Diamond(a\wedge b) & \Diamond(b\wedge c) & \Diamond(a\wedge c) \\ \Diamond a & \Diamond b & \Diamond c \end{array}\right\}$$

EXH then excludes all the IE alternatives and asserts all the II altrnatives. The truth conditions in (16) then are derived, which amount to saying that for any professor x, you are allowed to talk to x, but you are not allowed to talk to more than one. Crucially, after exhaustification, this envirnoment is SDE: it follows from (16) that for any subset of professors, you are allowed to talk to any of their members, but you are not allowed to talk to more than one. Given that exhaustification may render the scope of a possibility modal SDE, *any* is grammatical therein.

(16) a. ◇(∃x∈D[x is a professor and you talk to x])∧
∀D'⊆D: ◇(∃x∈D'[x is a professor and you talk to x])∧
∀D'[D'⊆D∧|D'∩⟦*professor*⟧|≥2]: ¬◇(∀x∈D'∩⟦*professor*⟧: you talk to x)

b. ◇(a∨b∨c) ∧ ◇a∧ ◇b ∧ ◇c ∧ ¬◇(a∧b∧c) ∧ ¬◇(a∧b) ∧ ¬◇(b∧c) ∧ ¬◇(a∧c)

The scope of a necessity modal is not SDE *per se*, either: on the grounds where in all (accessible) worlds w there is some professor x and you talk to x, it does not follow that in all these worlds there is some full professor x and you talk to x. Nonetheless, it cannot be turned SDE even after the application of exhaustification. Along with the assumptions laid out above, (2b) may be parsed as in (17); EXH then operates on the set C of alternatives to the prejacent shown in (18).

(17) LF of (2b)/(3b): [EXH-*C* [$_S$ □ [*any professor* [1 [*you talk to* t_1]]]]]

(18) Let D∩⟦*professor*⟧={a, b, c};
the alternative set C in (17)=: (IE; II)

$$\left\{\begin{array}{ccc} & \Box(a\vee b\vee c) & \\ \Box(a\vee b) & \Box(b\vee c) & \Box(a\vee c) \\ \Box a & \Box b & \Box c \end{array}\right\}\cup\left\{\begin{array}{ccc} & \Box(a\wedge b\wedge c) & \\ \Box(a\wedge b) & \Box(b\wedge c) & \Box(a\wedge c) \\ \Box a & \Box b & \Box c \end{array}\right\}$$

The truth conditions in (21) then are derived, which amount to saying that you are required to talk to some professor, and any professor in D is an option, and you are not required to talk to all the professors. These truth conditions are not SDE: for instance, that you are required to talk to some professor does not entail that you are required to talk to some full professor.

(19) a. $\Box(\exists x \in D[x \text{ is a professor and you talk to } x]) \wedge$
$\forall x \in D \cap [\![prof]\!]: \Diamond(\text{you talk to } x) \wedge$
$\forall D' \subseteq D: \neg\Box[\forall x \in D' \cap [\![prof]\!]: \text{you talk to } x]$

b. $\Box(a \vee b \vee c) \wedge \Diamond a \wedge \Diamond b \wedge \Diamond c \wedge \neg\Box(a \wedge b \wedge c) \wedge \neg\Box(a \wedge b) \wedge \neg\Box(b \wedge c) \wedge \neg\Box(a \wedge c)$

Given that the scope of a necessity modal does not support an SDE inference with or without the application of exhaustification, *any* is ungrammatical in this environment.

Mandarin *rènhé*, just like *any*, is grammatical in the scope of a possibility modal but not in that of a necessity one. Hence, as far as we could see, Crnič's proposal to *any* can be straightforwardly extended to Mandarin *rènhé*: with the analysis outlined above, *rènhé* is grammatical in the scope of a possibility modal (e.g., (3a)/(4a)) because this environment is SDE after exhaustification; on the other hand, the scope of a necessity modal cannot be SDE with or without exhasutification and therefore cannot host *rènhé* (see, e.g., (3b)/(4b)).

4 The amelioration effect from *dou*

What is then left to be explained is why the ungrammaticality of *rènhé* in the scope of a necessity modal may be ameliorated by the presence of *dou* (see, e.g., (3c)/(4c)). Along with Crnič's approach, we suggest that this is because *dou* introduces a universal quantificational force, which in turn renders the scope of a necessity modal SDE. In our analysis, (3c), where *rènhé* is rescued by the presence of *dou*, is parsed as in (20).

(20) LF of (3c): [*dou-C'* [$_{S'}$ EXH-*C* [$_{S}$ $\Box$ [*rènhé*$_{D}$ *professor* [1 [*you talk to* t_1]]]]]]

Before we show how this idea together with the LF in (20) may work, two additional assumptions are needed and will be introduced below; one has to do with the lexical meaning of *dou*, and the other is alternative pruning.

4.1 The universal force of *dou*

As shown in (5) and (21), the presence of the quantificational adverb *dou* introduces a universal/distributive flavor. This has led several research to encode a universal

quantificational force in its lexical meaning (e.g., Lee 1986; Cheng 1995; Lin 1998; and others).

(21) Zhāngsān, Lǐsì hé Wángwǔ dōu xiào-lė.
ZS LS and WW DOU laugh-PERF
'Each of ZS, LS and WW laughed.'

In our analysis, along with these research, it is the universal quantificatioanal force brought in by *dou* that improves the grammaticality of *rènhé* in the scope of a necessity modal.

There have been various proposals for the lexical meaning of *dou* in the literature; given the space limit, we are unable to go over these proposals in detail. As we have hinted above, what concerns us most is the universal quantificational force it may introduce. For the ease of discussion, below we assume the semantics of *dou* in (22), according to which it universally quantifies over the alternatives to its sister at LF. In other words, *dou* asserts that its prejacent as well as the alternatives to the prejacent are all true. With this assumption, *dou* has a very similar semantic contribition to that of Japanese *-mo* in Shimoyama 2006 or the universal-closure operator in Menéndez-Benito 2010.

(22) $[\![dou]\!]^{w}=\lambda C_{\langle\langle s,\,t\rangle,\,t\rangle}.\ \lambda p_{\langle s,\,t\rangle}.\ \forall p' \in C\text{: } p'(w)$

(23) illustrates how this semantics of *dou* works: assuming that the alternative set *dou* operates on consists of the 'sub-alternatives' of the prejacent (see (23b); cf. Xiang 2020), the truth conditions derived (see (23c)) amount to saying that each of ZS, LS and WW laughed.

(23) a. LF of (21): [*dou-C'* [*ZS&LS&WW*$_{F}$ *laughed*]

b. The alternative set C' in (21)=:

$$\left\{\begin{array}{ccc} & \text{LAUGH}(\text{ZS}\oplus\text{LS}\oplus\text{WW}) & \\ \text{LAUGH}(\text{ZS}\oplus\text{LS}) & \text{LAUGH}(\text{LS}\oplus\text{WW}) & \text{LAUGH}(\text{ZS}\oplus\text{WW}) \\ \text{LAUGH}(\text{ZS}) & \text{LAUGH}(\text{LS}) & \text{LAUGH}(\text{WW}) \end{array}\right\}$$

c. $\forall p \in C'$: p(w)=1

dou occurs with the universal quantifier *every*-CL *N* as well, as shown in (24). In this case, the set C' of alternatives *dou* operates constitutes its prejacent *every student laughed* and the scalar alternative to the prejacent, namely *some student laughed* (cf. Liu 2021). *dou* then asserts that all these alternatives are true, as shown in (25c); given that in this case, the prejacent entails its scalar alternative, the contribution of *dou* is somewhat vacuous.

(24) Měi-gė xuéshēng dōu xiào-lė.
every-CL student DOU laugh-PERF
'Every student laughed.'

(25) a. LF of (24): [*dou-C* [*every*-CL *student*$_F$ *laughed*]]

b. ALT((24))=C=:
$\left\{ \begin{array}{l} \textit{every student laughed}, \\ \textit{some student laughed} \end{array} \right\}$

c. $\forall p \in$ ALT((25b)): p(w)=1

This treatment of *dou* is surely far from adequate once a broader range of data are taken into consideration. For instance, (22) could lead to the wrong prediction in (26): suppose that the alternative set *dou* operates on in (26) constitues *every student laughed*, *most students laughed*, and *some student laughed*, we then wrongly predict that (26) is true iff every student laughed. More needs to be said here; but for the discusion below to proceed, it seems to us that (22) is convenient and sufficient. The crucial point is that *dou* endoceds in its lecial meaning a universal quantificational foce over the alternatives to its prejacent.

(26) Dabufen-de xuesheng dou xiao-lė.
most-MOD student DOU laugh-PERF
'Most students laughed.'

4.2 Alternative pruning

Some assumptions are needed on the alternative set C that EXH operates on in (20). First, we assume that the scalar alternatives to the prejacent in (20) are pruned. The idea of alternative pruning has been suggested in various research on exhaustification, including Fox & Katzir 2011; Chierchia 2013; Chierchia & Liao 2015; Chierchia, Fox & Spector 2012; and others. For instances, to derive the free choice implicature ($\Diamond$p and $\Diamond$q) from a disjunction under possibility modal $\Diamond(p \vee q)$, the scalar alternative $\Diamond(p \wedge q)$ may be removed from the alternative set before exhaustification applies (e.g., Chierchia 2013; Chierchia & Liao 2015; and others). Along with these proposals, we suggest that the scalar alternatives to the prejacent of EXH in (20) may be pruned before exhaustification applies. In other words, while in (20) *rènhé* triggers an alternative set as in (18), the scalar alternatives where $|D' \cap P| \geq 2$ are pruned before exhaustification applies.

Lastly, we assume that the domain alternatives that EXH operates on in (20) are pre-exhaustified. This is in accord with the assumption in various work on exhaustification that the alternatives to the prejacent of EXH may be exhaustified before EXH operates (see, e.g., Chierchia 2013).

Along with these assumptions, the set of alternatives C in (20), which EXH operates on, may be illustrated as in (27).

(27) EXH operates on ALT(S);

ALT(S)=: (IE; II)

$$\left\{ \begin{array}{ccc} & \Box(a\vee b\vee c) & \\ \Box(a\vee b)\wedge\neg\Box(c) & \Box(b\vee c)\wedge\neg\Box(a) & \Box(a\vee c)\wedge\neg\Box(b) \\ \Box a\wedge\neg\Box(b\vee c) & \Box b\wedge\neg\Box(a\vee c) & \Box c\wedge\neg\Box(a\vee b) \end{array} \right\}$$

EXH then operates on the alternative set in (27) and excludes the rest of the IE alternatives; as the result, the truth conditions in (28) are derived for the constituent *S'* in (20).

(20) LF of (3c): [*dou-C'* [$_{S'}$ EXH-*C* [$_{S}$ □ [*rènhé*$_{D}$ *professor* [1 [*you talk to* t_1]]]]]]

(28) $[\![S']\!]^{w}$=1 iff □(a∨b∨c) ∧ □(a)↔□(b∨c) ∧ □(b)↔□(a∨c) ∧ □(c)↔□(a∨b)

Note that these truth conditions are not SDE, either. Nonetheless, as shown in the following, pruning the scalar alternatives together with the universal quantification force from *dou* may render (20) SDE and hence have *rènhé* rescued.

4.3 The rescue mission

Along with the assumptions above, the amelioration effect from *dou* may be accounted for as follows. As shown in the LF (20), *dou* operates on the alternative set C' to the exhaustified necessity modal statement *S'* (see (28)).

(29) *dou* operates on C'; C'=:

$$\left\{ \begin{array}{ccc} \Box(a\vee b\vee c)\wedge(\Box(a)\leftrightarrow\Box(b\vee c))\wedge(\Box(b)\leftrightarrow\Box(a\vee c))\wedge(\Box(c)\leftrightarrow\Box(a\vee b)), & & \\ (\Box(a\vee b)\wedge\Box(a)\leftrightarrow\Box(b)), & (\Box(b\vee c)\wedge\Box(b)\leftrightarrow\Box(c)), & (\Box(a\vee c))\wedge\Box(a)\leftrightarrow\Box(c)) \\ \Box a, & \Box b, & \Box c \end{array} \right\}$$

dou then asserts that all the members in C' are true (i.e., the conjunction of all the alternatives in C' is true), as shown in (30). With the alternative set in (29), what *dou* asserts amount to saying is that all of □a, □b and □c are true (see (30b-c)); in other words, these truth conditions say that for all x such that x is a professor in D, you are required to talk to x.

(30) a. ∀p∈C': p(w)=1

b. □a∧□b∧□c

c. For all x such that x is a professor, □(you talk to x)

With these truth conditions, (20) is SDE: it follows from these truth conditions in (30) that for all full professors x, you are required to talk to x. The *Any* condition hence is satisfied, and *rènhé* in (3c) is grammatical with the presence of *dou*, as predicted.

5 When does *dou* fail to rescue *rènhé*?

We have suggested that the ungrammaticality of *rènhé* in the scope of a necessity modal is ameliorated by the presence of *dou* because of the universal force *dou* introduces. *dou* alone, however, does not license *rènhé*, as already shown in (6), and, at first glance our proposal might run the risk of leading to the wrong prediction.

(6) * Zhāngsān rènhé shū dōu dú-lė.
Zhangsan RN book DOU read-PERF

Along with our proposal, (6) may be parsed as (31-33): in (31), *dou* occurs above EXH, whereas in (32) it is under EXH; on the other hand, in (33), EXH is absent. Below we show that these LFs may be ruled out by independent constraints and hence as a consequence the presence of *rènhé* is ungrammatical.

(31) LF 1: *dou*$\prec$EXH
[*dou-C'* [$_{S'}$ EXH-*C* [$_{S}$ *rènhé*$_{D}$ *book* [1 [*Zhangsan read* t_1]]]]]

(32) LF 2: EXH$\prec$*dou*
[EXH-*C* [$_{S'}$ *dou-C'* [$_{S}$ *rènhé*$_{D}$ *book* [1 [*Zhangsan read* t_1]]]]]

(33) LF 3: *dou*; no EXH
[*dou-C'* [*rènhé*$_{D}$ *book* [1 [*Zhangsan read* t_1]]]]

5.1 EXH$\prec$*dou*

With the LF (31), EXH operates on the alternatve set C as in (34), the set of alternatives triggerd by *rènhé*. After exhaustification, *S'* is assigned the truth conditions as in (35) .

(31) LF 1: *dou*$\prec$EXH
[*dou-C'* [$_{S'}$ EXH-*C* [$_{S}$ *rènhé*$_{D}$ *book* [1 [*Zhangsan read* t_1]]]]]

(34) Let $D \cap [\![book]\!]=\{a, b, c\}$, C=: (IE; II)

$$\left\{ \begin{array}{ccc} & (a\vee b\vee c) & \\ (a\vee b) & (b\vee c) & (a\vee c) \\ a & b & c \end{array} \right\} \cup \left\{ \begin{array}{ccc} & (a\wedge b\wedge c) & \\ (a\wedge b) & (b\wedge c) & (a\wedge c) \\ a & b & c \end{array} \right\}$$

(35) $[\![S']\!]=1$ iff $(a\vee b\vee c)\wedge\neg(a\wedge b)\wedge\neg(b\wedge c)\wedge\neg(a\wedge c)\wedge\neg(a\wedge b\wedge d)$

dou then universally quantifies over the alternatives to the exhaustified proposition expressed by *S'*. Nonetheless, asserting that all the alternatives to *S'*are true leads to contradiction, given that the prejacent of *dou*, namely what *S'* expresses (see (35)), and the scalar alternative $(a\wedge b\wedge c)$ cannot both be true. Consequently, this LF is ruled out.

One might attempt to save this LF by appealing to the pruning of the scalar alternatives (i.e., the red ones) in (34); this way, EXH then only operates on the domain alternatives to its prejacent. Nonetheless, this renders the appending of EXH to the constituent *S* vacuous, given that none of the domain alternatives are innocently excludable. In other words, in this case, $[\![S']\!] \cong [\![S]\!]$ in (31). Consequently, this LF is ruled out given the constraint in (36).

(36) Appending EXH to *S* is not licensed if $[\![\text{EXH } S]\!] \cong [\![S]\!]$ or $[\![\text{EXH } S]\!]$ is weaker than $[\![S]\!]$. (Chierchia et al. 2012; Fox & Spector 2018; and others).

5.2 EXH$\prec$*dou*

In another possible LF (32), EXH is appended on top of *dou*. In this configuration, *dou* universally quantifies over the alternatives triggered by *rènhé*, which is already shown in (34). With *dou*-quantification, *S'* then amounts to saying that Zhangsan read every book in D. EXH then operates on the set C of alternatives to its prejacent *S'*, which is shown in (38).

(32) LF 2: EXH$\prec$*dou*
[EXH-*C* [$_{S'}$ *dou-C'* [$_{S}$ *rènhé*$_{\text{D}}$ *book* [1 [*Zhangsan read* t_1]]]]]

(37) $[\![S']\!]^{w}$=1 iff (a$\wedge$b$\wedge$c)$\cong$
For all x$\in$D such that x is a book, ZS read x.

(38) In (32), C=:
{[λw. For all x$\in$D'$\cap[\![book]\!]^{w}$: ZS read x in w]: D'$\subseteq$D and D'$\cap[\![book]\!]^{w}\neq\varnothing$}

Exhaustification in this LF however simply returns its prejacent *S'* (see (37)), given that the prejacent *S'* entails all the other alternatives in C. The appending of EXH in this LF, again, is vacuous, and consequently, this LF is ruled out given the constraint in (36).

5.3 *dou*; no EXH

In the third possible LF, EXH is not appended; and just like in (33), *dou* quantifies over the alternatives triggered by *rènhé* and gives rise to the meaning of *S'* in (33), as shown in (37).

(33) LF 3: *dou*; no EXH
[$_{S'}$ *dou-C'* [$_{S}$ *rènhé*$_{\text{D}}$ *book* [1 [*Zhangsan read* t_1]]]]

The truth conditions derived from this LF representation, namely (37), are SDE; it follows from these truth conditions that for any subset D' of the books in D, ZS read

every book in D'. Hence, at first glance, it seems that with this LF, (6) is hospitable to *rènhé*, which is contrary to what we have observed.

Note however that the truth conditions derived from this LF are identitcal to that of (39), which differs from (6) only in the DP *dou* accompanies. This may then render the LF (33) be ruled out by the principle in (39).

(39) Zhangsan **měi-běn shū** dōu dú-lė.
Zhangsan every-CL book DOU read-PERF
'Zhangsan read every book.'

(40) **Efficiency**: An LF ϕ is ruled out if there is a distinct competitor ψ such that i) $\psi \in \text{ALT}(\phi)$, and ii) $[\![\phi]\!] \cong [\![\psi]\!]$ (Meyer 2013, 2014, 2015)

It has been assumed that *any*, which denotes an existential quantifier *per se*, has a universal scalar alternative (e.g., Chierchia 2013 and others). Crucially, as shown in (41), the LF of (39) may merely differ from (33) on the DP *dou* accompanies and hence is a competitor to (33). Given that these two LF representations, namely (33) and (41), lead to the same truth conditions, (33) is ruled out by the principle Efficiency in (40).

(41) LF of (39): [*dou-C'* [***měi-běn*** *book* [1 [*ZS read* t_1]]]]]]

6 Conclusion

Above we have provided an account for the distribution of the Mandarin PSI *rènhé* in modal sentences and the amerlioration effect from the quantificational adverb *dou*. Along with the two-layered approach to PSI licensing in Crnič (2019a,b, 2022), we suggest that the ungrammaticality of *rènhé* in a necessity modal sentence may be ameliorated by the presence of *dou* because the universal quantificational force *dou* introduces renders a(n) (exhaustified) necessity modal sentence SDE; consequently, The *Any* Condition (12) is met, and *rènhé* is grammatical therein. To the extent that our analysis is on the right track, it shows that Crnič's two-layered approach might have superiority over the exhaustification-based approach in capturing the distribition of *rènhé* in modal environments.

Our account is built on the assumption that the quantificational adverb *dou* introduces a universal quantificational force. Hence, it might possibly shed light on the characterization of the meaning of the quantificational adverb *dou* as well: contra to several recent proposals which do not consider *dou* to be a universal operator *per se* (see, e.g., Xiang 2020; Liu 2021; and others), our analysis, in line with Lee 1986; Cheng 1995; and others, suggests that it is essential to encode a universal quantification force in its semantic contribution, though further investigation is needed.

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