Disjunctive Mention-all Answers[1]

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Questions in Logic and Semantics. University van Amsterdam. October 2015.

1. Introduction

- $\Diamond$-questions admit both mention-some (MS) and mention-all (MA) answers (Groenendijk & Stokhof 1984). In particular, the MA answer can take either a conjunctive form or a disjunctive form.

(1) Where can we get gas?
(*w: there are only two accessible stations, A and B.*)
a. Station A. — MS
b. Station A and Station B. — Conjunctive MA
c. Station A or Station B. — Disjunctive MA

In absence of *can*, or if the *wh*-complement is singular, a disjunctive answer can only be a partial answer.

(2) At which station can we get gas?
Station A or station B. (I don't know which one exactly) — Partial only

(3) Where did John get gas?
Station A or station B. (I don't know which one exactly) — Partial only

- **Goal:** to derive disjunctive MA answers in $\Diamond$-questions via a novel exhaustifier O_{DOU}, a covert counterpart of the Mandarin particle *dou*.

- Key data of *dou*:
  - Presence of *dou* above the weak modal blocks MS.
  - *Dou*+$\Diamond$ licenses the $\forall$-FC uses of pre-verbal disjunctions.

(4) Wo **dou** keyi zai nali mai kafei?
I DOU can at where buy coffee
'Where can I buy coffee? ($^{\text{OK}}$MA, # MS)'

(5) [Yuehan huozhe Mali] **dou** keyi jiao hanyu.
John or Mary DOU can teach Chinese
Intended: 'Both John and Mary can teach Chinese.'

Roadmap:
- Basics of MS/MA ambiguity
- Disjunctive answers
- Mandarin particle *dou*: an exhaustifier on pre-exhaustified sub-alternatives
- Deriving disjunctive MA answers via a covert *dou*

[1] I thank Gennaro Chierchia, Danny Fox, and Jim Huang for helpful comments and discussions. All errors are mine.

2. Basics of MS/MA ambiguity

2.1. Fox (2013)

- Earlier works treat MS/MA ambiguity as a pragmatic phenomenon.
- Fox (2013) proposes a semantic approach to capture the MS/MA ambiguity of $\Diamond$-questions:

  Ans(Q)(w) returns the set of *maximally informative* (MaxI) true answers of Q in w, each of which is a good answer. A true answer is MaxI iff it is not asymmetrically entailed by any true answers. A question admits MS iff it can have multiple MaxI true answers (i.e. the answer space is not closed under conjunction)

  (6) $\mathrm{Ans}(Q)(w) = \{p : w \in p \in Q \wedge \forall q[w \in q \in Q \to q \not\subset p]\}$

- In German, presence of *alles* above the weak modal blocks MS. (Manuel Križ and Martin Hackl p.c. to Fox 2015)

  (7) *MS possible* ($\Diamond$ > *alles*)

  Was kann ich **alles** mit 3 Euros kaufen?
  What can I all with 3 Euros buy

  (8) *MA only* (*alles* > $\Diamond$)

  Was **alles** kann ich mit 3 Euros kaufen?
  What alles can I with 3 Euros buy

  The *wh*-trace X has a covert distributor Each as a phrase-mate. A $\Diamond$-question can have multiple MaxI true answers (i.e. not closed under disjunction) when $\Diamond$ > [X Each].

  (9) Who can chair the committee?
  (w: only John and Mary can chair the committee; one chair only.)

  a. i. $Q = \{\Diamond \textsc{Each}(X)(\lambda x.chair'(x)) : X \in {}^*person'\}$
     ii. $Q_w = \{\underline{\Diamond chair'(j)}, \underline{\Diamond chair'(m)}\}$
     iii. $\mathrm{Ans}(Q)(w) = \{\Diamond chair'(j), \Diamond chair'(m)\}$ — MS

  b. i. $Q = \{\textsc{Each}(X)(\lambda x.\Diamond chair'(x)) : X \in {}^*person'\}$
     ii. $Q_w = \{\Diamond chair'(j), \Diamond chair'(m), \underline{\Diamond chair'(j) \wedge \Diamond chair'(m)}\}$
     iii. $\mathrm{Ans}(Q)(w) = \{\Diamond chair'(j) \wedge \Diamond chair'(m)\}$ — MA

- But, there should be other ways to capture MS/MA ambiguity: first, (7) can still take MA; second, this analysis cannot derive disjunctive MA answers grammatically.

2.2. Local exhaustification

- **Puzzle**: (10b), which is intuitively a good MS answer (cf. 10a), is asymmetrically entailed by (10c).

  (10) Who can serve on the committee?
  (w: the committee can be made up of either Gennaro+Danny or Gennaro+Danny+Jim)

  a. # Gennaro. — $\Diamond[serve'(g)]$
  b. √ Gennaro and Danny. — $\Diamond[serve'(g \oplus d)]$
  c. √ Gennaro, Danny, and Jim. — $\Diamond[serve'(g \oplus d \oplus j)]$

  I assume (i) that the question goal restricts the teleological modal base as (11), and (ii) the weak modal *can* embeds an exhaustivity operator O associated with the *wh*-trace.

  (11) M = {w: there is a group of individuals X s.t. X form the committee in w}

  (12) $O(p, Q) = p \wedge \forall q \in \mathrm{NW}(p, Q)[\neg q]$, where $\mathrm{NW}(p, Q) = \{q : q \in Q \wedge p \not\subseteq q\}$

  – (10a) is false. $\Diamond_{w,M} O[serve'(g)]$ means "among the accessible world to w where some X forms the committee, there is a world w' s.t. only Gennaro serves on the committee in w'."
  – O creates a non-monotonic environment w.r.t. the *wh*-trace; thus both (10b-c) are MaxI true answers. $\Diamond_M O[serve'(g \oplus d \oplus j)] \not\Rightarrow \Diamond_M O[serve'(g \oplus d)]$

3. Disjunctive answers

- $\Box$-questions admit elided disjunctive answers as complete answers. (Spector 2007, 2008)

(13) "What does John have to read?"
"*Semantics* or *Pragmatics*." ($^{\text{OK}}$*or* > *have to*; $^{\text{OK}}$ *have to* > *or*)
a. *John either has to read S or has to read P.*
b. *John can read S or P, and he has to read one of them.*

But in a singular $\Box$-question, a disjunctive answer can only take an ignorance reading. (Fox 2013)

(14) "Which book does John have to read?"
"*Semantics* or *Pragmatics*." ($^{\text{OK}}$*or* > *have to*; # *have to* > *or*)

⇒ Bare *wh*-words like *what* (and plural *wh*-phrases like *which books*) also quantify over generalized quantifiers like $s \vee p$, yielding higher-order disjunctive answers; while singular wh-phrases like *which book* only quantify over atomics.

(15) $s \vee p = \lambda f_{est}.\lambda w.f_w(s) \vee f_w(p)$ $\qquad \Box f(s \vee p) = \Box[f(s) \vee f(p)]$

- Fox (2013): an answer p can be a complete answer of Q iff it is possible that p is true while no answer stronger than p is true: $\exists w[p(w) \wedge \neg\exists q \in Q[q \subset p \wedge q(w)]]$

In Fig. 1, the disjunctive answer being true ⇒ one of the individual answers being true;
In Fig. 2, the disjunctive answer being true $\not\Rightarrow$ one of the individual answers being true;
∴ a disjunctive answer can be a complete answer to a $\Box$-question but not to a non-modalized question.

$$\begin{array}{ccc} f(a) & \vee & f(b) \\ \searrow & \updownarrow & \swarrow \\ & f(a \vee b) & \end{array} \qquad\qquad \begin{array}{ccc} \Box f(a) & \vee & \Box f(b) \\ \searrow & \downarrow & \swarrow \\ & \Box f(a \vee b) & \end{array}$$

Fig. 1 Fig. 2

- Spector (2007): an answer p can be a complete answer of Q iff $O_Q(p)$ isn't contradictory.

(16) a. $Of(a \vee b) = f(a \vee b) \wedge \neg f(b) \wedge \neg f(a) \wedge ... = \perp$
b. $O\Box f(a \vee b) = \Box f(a \vee b) \wedge \neg\Box f(b) \wedge \neg\Box f(a) \wedge ... \neq \perp$

- **Puzzle:** *Why is that a disjunctive answer can be a complete answer of a* $\Diamond$*-question?*

$$\begin{array}{ccc} \Diamond f(a) & \vee & \Diamond f(b) \\ \searrow & \updownarrow & \swarrow \\ & \Diamond f(a \vee b) & \end{array} \qquad\qquad \begin{array}{ccc} \Diamond Of(a) & \vee & \Diamond Of(b) \\ \searrow & \updownarrow & \swarrow \\ & \Diamond Of(a \vee b) & \end{array}$$

Fig. 3 Fig. 4

In Fig. 3-4, the disjunctive answer being true ⇒ one of the individual answers being true.

(17) $\Diamond O[f(a) \vee f(b)]$
$= \Diamond[[f(a) \vee f(b)] \wedge \neg[f(a) \wedge f(b)] \wedge \neg f(c)]$
$= \Diamond[[f(a) \wedge \neg f(b) \wedge \neg f(c)] \vee [f(b) \wedge \neg f(a) \wedge \neg f(c)]]$
$= \Diamond[Of(a) \vee Of(b)]$
$= \Diamond Of(a) \vee \Diamond Of(b)$

4. Mandarin particle *dou*

4.1. Mandarin *dou* in *wh*-questions

- In *wh*-questions, *dou* forces MA. Like *alles*, presence of *dou* above the weak modal blocks MS. Under this use, *dou* must c-command the *wh*-item; but it appears after the subject if the subject isn't interrogative.

(18) (# **Dou**) [shui] lai -le? Ju ji-ge lizi jiu xing.
DOU who come -ASP? show some-CL example just enough.
'(#All) who came? Showing (me) some examples is enough.'

(19) Wo **dou** keyi zai [nali] mai kafei?
I DOU can at where buy coffee
'Where all can I buy coffee?' ($^{\text{OK}}$MA; # MS)

- *Dou* cannot be used in a singular question.

(20) Dou [na -xie/*-ge ren] lai -le?
DOU what -CL$_{pl}$/-CL$_{sg}$ person come -ASP
"Who all came?"/"*Which person all came?"

- I argue that the meaning of *dou* is very different from that of *alles*, and that *dou* is the source of disjunctive MA answers in $\diamond$-questions.

4.2. Mandarin *dou* in declaratives

- The Mandarin particle *dou* has various uses: ∀-quantifier & distributor, scalar indicator, ∀-FCI licenser, minimizer-licenser; but German *alles* and Southern English *all* only have the quantifier & distributor use.

– *∀-quantifier & distributor*

(21) a. [Tamen] **dou** mai -le fangzi.
they DOU buy -ASP houses
'They **dou** bought houses.' (# collective)

b. [ABC/*AB] **dou** shi pengyou.
ABC/AB DOU be friend
'ABC/*AB are all friends.'

– *Scalar marker*

(22) a. Ta **dou** lai -guo [SAN] -ci -le.
he DOU come -EXP three time -ASP.
'He has been (here) three times.'
⇝ Being here three times is a lot.

b. **Dou** [WU] dian -le.
DOU five o'clock -ASP
'It is five o'clock.'
⇝ Being five o'clock is a bit late.

– *∀-FCI licenser*

(23) a. [Yuehan huozhe Mali] **dou** *(keyi) jiao hanyu.
John or Mary DOU can teach Chinese
'Both John and Mary can teach Chinese.'
$\not\Rightarrow$ Only John and Mary can teach Chinese.
$\not\Rightarrow$ It is not allowed to let John and Mary both teach Chinese.

b. Ni zai [xingbake huozhe maidanglao] **dou** *(keyi) mai-dao kafei.
you at Starbucks or McDonalds DOU can buy-ASP coffee.
'From both Starbucks and McDonalds, you can get coffee.'

4.3. Defining *dou* as a pre-exhaustification exhaustifier

- Xiang (2015b) defines *dou* as a presuppositional exhaustifier that (i) operates on sub-alternatives and (ii) has a pre-exhaustification effect.

(24) a. $[\![$**dou** [J and M came]$]\!]$ = J and M came, not only J came, not only M came.
b. $[\![$**dou** [ABC are friends]$]\!]$ = ABC are friends, not only AB are friends, not only BC ...
c. $[\![$**dou** [it's five o'clock]$]\!]$ = it is five o'clock, not just four, not just three, ...
d. $[\![$**dou** [J or M can teach]$]\!]$ = J or M can teach, not only J can teach, and not only M can teach.

- **Quantifier & Distributor:**

(25) a. $\textbf{dou}(p, Q) = \exists q \in \text{Sub}(p, Q).\ p \wedge \forall q \in \text{Sub}(p, Q)[\neg O(q)]$
i. Presupposition: p has at least one sub-alternative.
ii. Assertion: p is true, the exhaustification of each p's sub-alternative is false.
b. $\text{Sub}(p, Q) = \{q : q \in Q \wedge p \subseteq q\}$ (the set of weaker alternatives) (To be revised)

The presupposition of *dou* captures the distributivity effect (cf. Lin 1996): to generate sub-alternatives, the prejacent of *dou* must be monotonic wrt the position associated with *dou*.

(21a′) '*abc* **dou** bought houses.'
a. × *abc* together bought houses.$\not\Rightarrow$ *ab* together bought houses.
$\text{Sub}(\textit{abc together bought houses}) = \emptyset$
b. √ Cov(*abc*) each bought houses. $\Rightarrow$ D each bought houses, where $D \subset \text{Cov}(abc)$
$\text{Sub}(\text{Cov}(abc)\ \textit{each bought houses}) = \{D\ \textit{each bought-houses} : D \subset \text{Cov}(abc)\}$

(21b′) '*abc*/**ab* **dou** are friends.'
a. $[\![\text{are friends}]\!] = \lambda x.\text{singular}(x) = 0.\textit{be-friends}(x)$
b. $\text{Sub}(\textit{abc are friends}) = \{\textit{ab are friends}, \textit{bc are friends}, \textit{ac are friends}\}$
c. $\text{Sub}(\textit{ab are friends}) = \emptyset$

- **∀-FCI licenser:** Applying *dou* to a disjunction negates the pre-exhaustified domain (D)-alternatives, yielding a ∀-FC inference.

(26) [John or Mary] **dou** can teach Chinese.
a. $\text{Sub}(\Diamond f(j) \vee \Diamond f(m)) = \{\Diamond f(j), \Diamond f(m)\}$
b. $[\![\textbf{dou}[\Diamond f(j) \vee \Diamond f(m)]]\!] = [\Diamond f(j) \vee \Diamond f(m)] \wedge \neg O \Diamond f(j) \wedge \neg O \Diamond f(m)$
$= [\Diamond f(j) \vee \Diamond f(m)] \wedge [\Diamond f(j) \rightarrow \Diamond f(m)] \wedge [\Diamond f(m) \rightarrow \Diamond f(j)]$
$= [\Diamond f(j) \vee \Diamond f(m)] \wedge [\Diamond f(j) \leftrightarrow \Diamond f(m)]$
$= \Diamond f(j) \wedge \Diamond f(m)$

Problem: But the D-alternatives are stronger than the disjunction, how could they be sub-alternatives?

(27) **Innocently (I)-excludable alternatives** (Fox 2007)
$\text{IExcl}(p, Q) = \{q : q \in Q \wedge \neg \exists q' \in \text{NW}(p, Q)[p \wedge \neg q \rightarrow q']\}$
($\{q$: affirming p and negating q doesn't entail any non-weaker alternative of $p\}$)

E.g. The D-alternatives are not I-excludable to the disjunction: $[\Diamond f(j) \vee \Diamond f(m)] \wedge \neg \Diamond f(j) \rightarrow \Diamond f(m)$

(28) **Sub-alternatives** (final version)
$\text{Sub}(p, Q) = Q - \text{IExcl}(p, Q) - \{p\}$
(the set of alternatives excluding innocently excludable alternatives and the prejacent)

5. Deriving disjunctive MA via covert *dou*

5.1. Disjunctives in $\Diamond$-questions

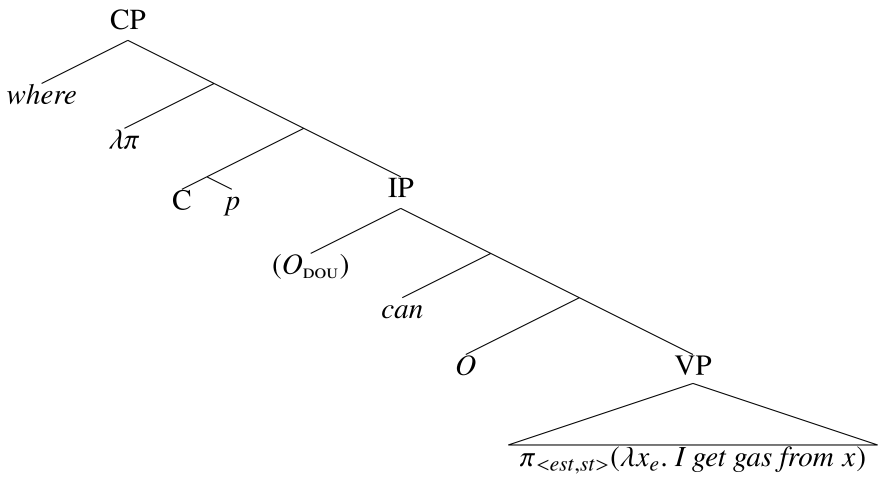
- I propose that the MS/MA ambiguity is attributed to the absence/presence of a covert *dou*:

(29) $O_{\text{DOU}}(p, Q) = p \wedge \forall q \in \text{Sub}(p, Q)[\neg O(q)]$

(30) Where can I get gas?

a. From station A. MS/Partial

b. From station A or station B. Partial/MA



(w: there are only two accessible gas stations: A and B; both of them have enough gas for me)

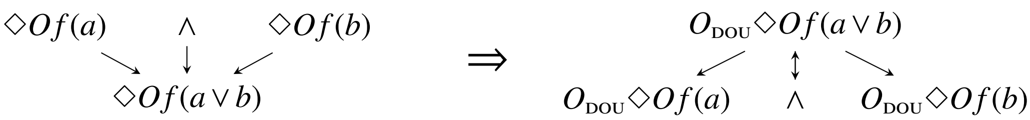


Fig. 5: MS (without O_{DOU}) Fig. 6: MA (with O_{DOU})

- Without O_{DOU},
  i. MS is available: the answer space is not closed under conjunction;
  ii. the disjunctive answer is partial: it is asymmetrically entailed by the individual ones.
- With O_{DOU}, the disjunctive answer equals to the conjunction of the individual answers, as in (31).
  i. MS is unavailable: the answer space closed under conjunction;
  ii. the individual answers are partial: they are asymmetrically entailed by the disjunctive answer.

(31) a. The embedded O uses up the scalar alternative and the focus alternatives.

$$\begin{aligned}\Diamond O[f(a) \vee f(b)] &= \Diamond[[f(a) \vee f(b)] \wedge \neg[f(a) \wedge f(b)] \wedge \neg f(c)] \\ &= \Diamond[[f(a) \wedge \neg f(b) \wedge \neg f(c)] \vee [f(b) \wedge \neg f(a) \wedge \neg f(c)]] \\ &= \Diamond[Of(a) \vee Of(b)]\end{aligned}$$

b. Applying O_{DOU} uses up the D/sub-alternatives, yields an FC inference:

$$\begin{aligned}O_{\text{DOU}}\Diamond O[f(a) \vee f(b)] &= \Diamond[Of(a) \vee Of(b)] \wedge \neg O\Diamond Of(a) \wedge \neg O\Diamond Of(b) \\ &= \Diamond[Of(a) \vee Of(b)] \wedge [\Diamond Of(a) \rightarrow \Diamond Of(b)] \wedge [\Diamond Of(b) \rightarrow \Diamond Of(a)] \\ &= \Diamond[Of(a) \vee Of(b)] \wedge [\Diamond Of(a) \leftrightarrow \Diamond Of(b)] \\ &= \Diamond Of(a) \wedge \Diamond Of(b)\end{aligned}$$

- **Puzzle:** why is that disjunctives cannot be complete answers of non-modalized questions?

(32) "Where did John get gas?"
"Station A or station B." Partial only

(33) $O_{\text{DOU}} f(a \vee b) = [f(a) \vee f(b)] \wedge \neg O f(a) \wedge \neg O f(b) = f(a) \wedge f(b)$

- For any possible answer p, there are two conditions for p being a complete answer:

(i) "p is true" $\not\Rightarrow$ "$\exists q \subset p$ [q is true]" (Fox 2013)
(ii) $O(p) \neq \bot$ (Spector 2007)

(33) does not pass condition (ii): the scalar alternative hasn't been used; exhaustifying (33) affirms the FC inference and negates the scalar alternative, yielding a contradiction.

(34) $O[O_{\text{DOU}} f(a \vee b)] = O_{\text{DOU}}(f(a) \vee f(b)) \wedge \neg[f(a) \wedge f(b)] \wedge \neg f(c)$
$= [f(a) \wedge f(b)] \wedge \neg[f(a) \wedge f(b)] \wedge \neg f(c)$
$= \bot$

5.2. Other questions

- **In singular questions**: O_{DOU} is vacuous; *dou* is undefined.

A singular *wh*-phrase lives on a set consisting of only atomic elements (Fox 2013). Singular answers have no sub-alternatives, thus O_{DOU} is vacuous.

(35) a. $\text{Sub}(f(a)) = \emptyset$
b. $O_{\text{DOU}}(f(a)) = f(a)$

The overt *dou* cannot be used in a singular question because of the presupposition failure.

(36) Dou [na -xie/*-ge ren] lai -le?
DOU what -CL$_{pl}$/-CL$_{sg}$ person come -ASP
'Who all came?'/'*Which person all came?'

- **In basic □-questions**: O_{DOU} is vacuous; *dou* is defined but vacuous

The D-alternatives of a □-disjunction are innocently excludable and thus are not used by O_{DOU}.

(37) $\Box(p \vee q) \wedge \neg\Box p \not\rightarrow \Box q$

(38) a. $\text{Sub}(\Box[p \vee q]) = \emptyset$
b. $O_{\text{DOU}}[\Box(p \vee q)] = \Box[p \vee q]$

Unlike singular answers, conjunctive and plural answers have sub-alternatives, which support the presupposition of *dou*. Therefore *dou* can be used in non-singular □-questions.

(39) a. $\text{Sub}(\Box[f(a) \wedge f(b)]) = \{\Box f(a), \Box f(b)\}$
b. $O_{\text{DOU}}\Box[f(a) \wedge f(b)] = \Box[f(a) \wedge f(b)] \wedge \neg O\Box f(a) \wedge \neg O\Box f(b) = \Box[f(a) \wedge f(b)]$

6. Conclusions

- MS/MA ambiguity of $\Diamond$-questions can be attributed to the absence/presence of O_{DOU}.
  - *dou*/O_{DOU} is an exhaustifier operating on pre-exhaustified sub-alternatives.

    (40) a. $\textbf{dou}(p,Q) = \exists q \in \text{Sub}(p,Q).p \wedge \forall q \in \text{Sub}(p,Q)[\neg O(q)]$
    b. $O_{\text{DOU}}(p,Q) = p \wedge \forall q \in \text{Sub}(p,Q)[\neg O(q)]$
    c. $\text{Sub}(p,Q) = Q - \text{IExcl}(p,Q) - \{p\}$

  - The answer space of a basic *wh*-question includes higher-order disjunctives (Spector 2007, 2008).
  - In a $\Diamond$-question, O_{DOU}/*dou* strengthens disjunctives into FC statements, making the answer space closed under conjunction and therefore blocking MS.

    (41) $O_{\text{DOU}}\Diamond Of(a \vee b) = \Diamond Of(a) \wedge \Diamond O(b)$

- p can be a complete answer of Q iff (i) p can be an MaxI true answer of Q and (ii) $O(p)$ isn't contradictory. $\Box$-disjunctives and strengthened $\Diamond$-disjunctives satisfy both conditions, while strengthened non-modalized disjunctions do not satisfy (ii).

Appendix I: Cf. extending Fox (2007)

- One may suggest to analyze *dou* as Fox's (2007) recursive exhaustification operator O_R: (i) exhaustification negates only *innocently excludable* alternatives; (ii) exhaustification applies recursively.

  In (42), 1st exhaustification negates scalar alternatives and focus (F)-alternatives; domain (D)-alternatives are not innocently excludable. 2nd exhaustification negates the pre-exhaustified D-alternatives.

  (42) $O_R\Diamond[f(a) \vee f(b)]$
  a. First exhaustification:
  $O\Diamond[f(a) \vee f(b)] = \Diamond[f(a) \vee f(b)] \wedge \neg\Diamond[f(a) \wedge f(b)] \wedge \neg\Diamond f(c) \cancel{\wedge \neg\Diamond f(a) \wedge \neg\Diamond f(b)}$
  b. Second exhaustification:
  $$\begin{aligned} O'O\Diamond[f(a) \vee f(b)] &= O\Diamond[f(a) \vee f(b)] \wedge \neg O\Diamond f(a) \wedge \neg O\Diamond f(b) \\ &= O\Diamond[f(a) \vee f(b)] \wedge [\Diamond f(a) \to \Diamond f(b)] \wedge [\Diamond f(b) \to \Diamond f(a)] \\ &= O\Diamond[f(a) \vee f(b)] \wedge [\Diamond f(a) \leftrightarrow \Diamond f(b)] \\ &= \Diamond f(a) \wedge \Diamond f(b) \wedge \neg\Diamond[f(a) \wedge f(b)] \wedge \neg\Diamond f(c) \end{aligned}$$

- O_R makes the answers mutually exclusive. Thus $O_R\Diamond[f(a) \vee f(b)]$ can be a complete answer.

  (43) "What is John allowed to read?" "Book A or Book B."
  a. $Q = \{O_R\Diamond\pi(\lambda x.read'(x)) : x \in {*thing'}\}$
  b. $Q_w = \{O_R\Diamond f(a \vee b)\}$
  c. $Ans_F(Q)(w) = \{O_R\Diamond f(a \vee b)\}$

  $O_R\Diamond f(a) \quad \vee \quad O_R\Diamond f(b)$

  $O_R\Diamond f(a \vee b)$

- But, exhaustifying with O_R yields a strongly exhaustive reading, which is too strong. A more common MA reading is the intermediately exhaustive reading (Klinedinst & Rothschild 2011; Cremers & Chemla 2014; Uegaki 2014; Xiang 2015a)[2]

  E.g. "John predicated who came."

  Strongly exhaustive: $\forall x$ [x came $\to$ J pred x came] $\wedge$ $\forall x$ [x didn't come $\to$ **not** [J pred x came]]

  Intermediately exhaustive: $\forall x$ [x came $\to$ J pred x came] $\wedge$ $\forall x$ [x didn't come $\to$ J pred x did**n't** come]

[2] One might suggest to insert an O below the weak modal so as to use up the F-alternatives locally: $O_R\Diamond Of(a \vee b)$. But local exhaustification is not available in a non-modalized question.

Appendix II: Spector's (2007) puzzle

- Given the contrast in (44a-b), Spector (2007) claims that $\Diamond$-questions cannot take disjunctions as complete answers: for (44b) being true, there must be some $X > 3$ s.t. t "$\Diamond$[Jack read X many books]" is true, which is stronger than (44b).

(44) a. i. What novels is Jack required to read?
ii. Jack is required to read [more than three novels by Balzac]$_F$. — Complete or Partial
b. i. What novels is Jack allowed to read?
ii. Jack is allowed to read [more than three novels by Balzac]$_F$. — Partial only

- In the present analysis, for any $X > 3$, "$\Diamond$(J read X books)" is a sub-alternative of "$\Diamond$(J read > 3 books)".

(45) $$\begin{aligned} O_{\text{DOU}}[\Diamond f(>3)] &= \Diamond f(>3) \wedge \forall X > 3[\neg O \Diamond f(X)] \\ &= \Diamond f(>3) \wedge \forall X > 3[\Diamond f(X) \rightarrow \Diamond f(X+1)] \\ &= \Diamond f(>3) \wedge \forall X > 3[\Diamond f(X) \rightarrow \Diamond f(X+1)] \wedge \exists X > 3[\Diamond f(X)] \\ &= \Diamond f(\infty) \end{aligned}$$

(46) $O_{\text{DOU}}[\Diamond f(>4)] = \Diamond f(\infty)$

(45) is bad because of replacing "3" with any number doesn't change the output meaning $\Diamond f(\infty)$, yielding a grammatical (G)-triviality (Gajewski 2002): "$O_{\text{DOU}} \Diamond f(>n)$" receives the same value regardless of how the lexical terminal n is replaced in the structure.

Appendix III: Modal obviations of ∀-FCI licensing

- The English polarity item *any* is licensed as a ∀-FCI when appearing over a weak modal, but not when it appears in an episodic statement or over a strong modal.

(47) a. *Anyone came in.
b. Anyone can/*must come in.

Likewise in Mandarin:

(48) [A huozhe B] dou *(keyi)/*bixu jiao jichu hanyu.
A or B DOU *(can)/*must teach introductory Chinese

- **Explanation:**

– The ∀-FC implicature evoked by *dou* contradicts the scalar implicature of the disjunction.

∀-FC: $f(a) \wedge f(b)$ SI: $\neg[f(a) \wedge f(b)]$

– But in a *dou*+$\Diamond$-sentence, there is a salvaging way to avoid this contradiction, i.e. assessing SI within the modal base: *only the worlds that satisfies the SI are accessible*.

(49) [A or B] **dou** can teach Chinese.
$\rightsquigarrow$ We are only considered with cases where only one person will teach Chinese.
$\not\rightsquigarrow$ Not that both John and Mary will teach Chinese.
a. SI pre-restricts the modal base M:
If $f = \{< w1, \{a\} >, < w2, \{b\} >, < w3, \{a, b\} >\}$, then $M = \{w1, w2\}$
b. Prejacent of *dou*: $\Diamond f(a) \vee \Diamond f(b)$
c. Applying *dou* yields a ∀-FC implicature: $\Diamond f(a) \wedge \Diamond f(b)$ — (True under M)

– This option doesn't work for *dou*+$\Box$-sentences: the ∀-FC implicature $\Box f(a) \wedge \Box f(b)$ is false under M.

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