Not Exhaustivity

Completeness and False Answers Sensitivity in Questions

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Exhaustivity in Questions and Answers – Experimental and theoretical approaches
Tübingen University, 13-14 June 2019

Conditions of question-embeddings

(1) Jenny knows Q.

a. Jenny knows a complete true answer of Q. **Completeness**

b. Jenny doesn't believe any false answers (FAs) of Q. **FA-sensitivity**

Example

Determine the truth value of the sentence "... knows who came."

Did ... come?	*a*	*b*	*c*		
Facts	✓	✓	✗		
Jenny's belief	✓	✓	?	☺	
Mary's belief	✓	?	?	☹	Violate Completeness
Sue's belief	✓	✓	✓	☹	Violate FA-sensitivity

The current dominant view

1. **Completeness = Exhaustiveness**
   Knowing the complete true answer means knowing the strongest true answer.
2. ***O* (Completeness) ⇒ FA-sensitivity**
   FA-sensitivity is a logical consequence of exhaustifying over Completeness.
   (Klinedinst & Rothschild 2011; Uegaki 2015; Cremers 2016; Theiler et al. 2018)

(2) Jenny knows Q. ≈ 'Jenny **only** knows the complete TRUE answer of Q.'

This presentation

1. **Completeness ⊃ Exhaustiveness**
   Mention-some (MS-)answers can serve as complete answers of MS questions.
2. ***O* (Completeness) ⇏ FA-sensitivity**
   FA-sensitivity doesn't come from exhaustification.

Part I. Completeness and Mention-some

What is mention-some?

Mention-all (MA) questions

Most questions admit only **exhaustive** answers. Non-exhaustive answers must be **ignorance-marked**, yielding undesired exclusive inferences otherwise.

(3) Who went to the party?
(w: *Only John and Mary went to the party.*)

a. John and Mary.\

b. John (L H*) did ...(L-H%)/ — **Partial answer**

b′. #John (H*) did.\ (L-L%) $\rightsquigarrow$ *Only John went to the party.*

Mention-some (MS) questions: questions that admit MS answers

Basic $\Diamond$-questions admit MS answers. Crucially, while being non-exhaustive, MS answers **do not need to be ignorance-marked**.

(4) Where can we get coffee?
(w: *There are only two accessible coffee stores: A and B.*)

a. Store A.\ $\not\rightsquigarrow$ *We can get coffee only from store A.* — **MS-answer**

b. Store A and Store B.\ — **Conj MA-answer**

c. Store A or Store B.\ — **Disj MA-answer**

Core issue: Are MS-answers partial or complete?

- If they are **partial**, why MS-questions are tolerated of incomplete answers?
- If they are **complete**, how can we define Completeness and derive MS? ✓

Plan

- Approaches to MS: pragmatic, post-structural, structural
- Evidence for structural approaches
- Deriving the MS/MA ambiguity

Approaches to mention-some

Pragmatic approaches (Gr&S 1984, Ginzburg 1995, van Rooij & Schulz 2004, a.o.)

Complete answers must be exhaustive. MS answers are partial answers that are sufficient for the conversational goal behind the question.

(5) Where can we get coffee?

a. to find a place to get some coffee. MS

b. to investigate the local coffee market. MA

Post-structural approaches (Beck & Rullmann 1999, George 2011: ch 2, a.o.)

MS and MA are two independent readings, derived via different operations on question roots. However, MS/MA ambiguity can only be explained by pragmatics.

E.g. B&R (1999): A question **unambiguously** denotes the Hamblin-Karttunen intension; it takes MS iff the employed **Ans-operator** is **existential**.

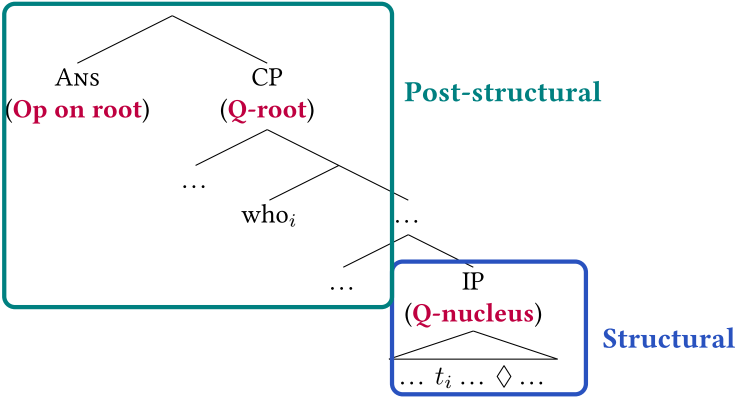
(6) a. $\text{Ans}_1(Q)(w) = \bigcap\{p \mid Q(w)(p) \wedge p(w)\}$ (for MA)

b. $\text{Ans}_3(Q)(w) = \lambda P_{\langle s,stt\rangle}.\exists p[P(w)(p) \wedge Q(w)(p) \wedge p(w)]$ (for MS)

Approaches to mention-some

Structural approaches (George 2011: ch. 6; Fox 2013; Xiang 2016ab)

MS/MA-answers are uniformly possible complete answers. The MS/MA ambiguity comes from minimal **structural variations** within the **question nucleus**.



Only structural approaches predict a grammatical relation between MS and ◊-modal.

Evidence for structural approaches

I. ◊-modal licenses MS-readings in various *wh*-constructions.

(7) **Free relatives** (Chierchia & Caponigro 2013)

a. Mary ate what Jenny bought.
b. John went to where he **could** get coffee.

(8) ***Wh*-conditionals in Mandarin** (Liu 2016)

a. Ni qu-guo nar, wo jiu qu nar.
you go-EXP where, I JIU go where
Intended: 'I will go to **every** place where you have been to.'

b. Nar **neng** mai-dao kafei, wo jiu qu nar.
where can buy-reach coffee, I JIU go where
Intended: 'I will go to **one** of the places where I can buy coffee.'

II. Experimental evidence (Appx) With the same conversational goal, presence of ◊-modal significantly increases the acceptance of MS. (Xiang & Cremers 2017)

Evidence for structural approaches

III. Mention-some = mention-one: Each MS answer specifies only one option.

1. In answering a **matrix** MS-question, **mention-few answers** are interpreted exhaustively if not ignorance-marked.

(9) Where can we get coffee in the food court?

a. Starbucks.\ $\not\rightsquigarrow$ *Only at Starbucks.* MS

b. Starbucks and Peet's.\ $\rightsquigarrow$ *Only at Starbucks and Peet's.* MF

c. Starbucks or Peet's.\ $\rightsquigarrow$ *Only at Starbucks and Peet's.* MF

Compare: partial answers of matrix MA-questions can be mention-few.

(10) Who is in your committee, for example?

a. Andy. $\not\rightsquigarrow$ *Only Andy is in my committee.*

b. Andy and Billy. $\not\rightsquigarrow$ *Only Andy and Billy are in my committee.*

Evidence for structural approaches (II)

2. **Indirect** MS-questions cannot take non-exhaustive mention-few readings, even if mention-few answers suffice for the conversational goal.

(11) (Context: *The dean wants to meet with 3 eligible committee chair candidates.*)

Jenny knows who can chair the committee.

✓ $\exists x$ [x can chair $\wedge$ J knows that x can chair] MS

✓ $\forall x$ [x can chair $\rightarrow$ J knows that x can chair] MA

✗ $\exists xyz$ [xyz each can chair $\wedge$ J knows that xyz each can chair] MF

A sample truth value judgment task (p.c. with Seth Cable):

Scenario

Norvin says to us, "On my exam, you'll have to name ... multiple *wh*-fronting."

1. ... **one** language that has ... [TRUE]
2. ... **all** the languages that have ... [?TRUE]
3. ... **three** languages that have ... [FALSE]

Test sentence

Norvin said that we'll have to know where we can find multiple *wh*-fronting.

Summarizing the evidence

1. $\Diamond$-modal licenses MS in various *wh*-constructions.
2. Significant effect of $\Diamond$-modal in licensing MS
3. Mention-some = mention-one

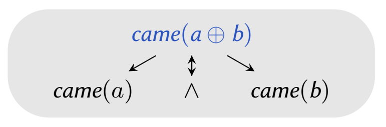
- ☞ There must be some grammatical relation between MS and $\Diamond$-modal.
- ☞ Structural approaches ✓

Next: A structural approach to mention-some (Xiang 2016b: chapter 2)

1. Weakening Completeness (Fox 2013)
2. Deriving mention-some (esp. mention-some = mention-one)
3. Deriving conjunctive and disjunctive mention-all

Weakening completeness

(12) Who came?
(*w: Only Andy and Billy came.*)



Completeness = Exhaustiveness/Strongestness

Dayal (1996): Only the **strongest** true answer (i.e., the unique true answer that entails all the true answers) completely answers a question.

(13) $\textsc{Ans}_{Dayal}(Q)(w) = \iota p[w \in p \in Q \wedge \forall q[w \in q \in Q \rightarrow p \subseteq q]]$

This view is advantageous in several respects but leaves no space for MS.

Completeness = Max-informativity

Fox (2013): Any true answer that is **max-informative** (i.e., not asymmetrically entailed by any true answers) is complete.

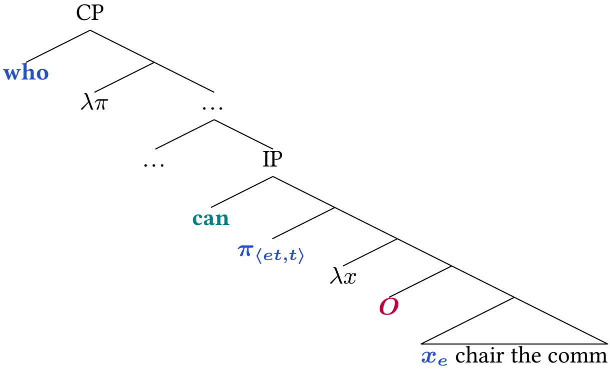
(14) $\textsc{Ans}_{Fox}(Q)(w) = \{p \mid w \in p \in Q \wedge \forall q[w \in q \in Q \rightarrow q \not\subset p]\}$

- ☞ A question takes MS iff it can have **multiple** max-inf true answers.
- ☞ A question takes MA if its answer space is **closed under conjunction**.

The *wh*-item takes a short IP-internal QR and then moves to [Spec, CP].

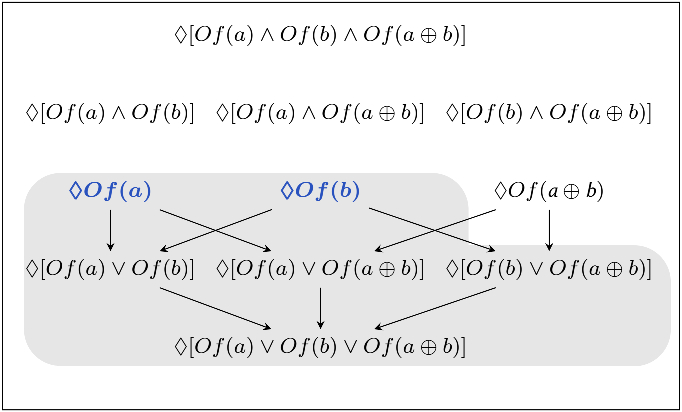
- The **individual** trace x_e is associated with a local ***O*-operator**.
- The **higher-order** trace $\pi_{\langle et,t\rangle}$ takes scope below the **◊-modal**.

(15) Who can chair the committee? (MS reading)



(16) Who can chair the committee?
$Q = \{\Diamond\pi(\lambda x.O[\textit{chair}(x)]) \mid \pi$ is a boolean con/dis-junction over *hmn*$\}$

(w: *Only Andy and Billy can chair the committee; single-chair only.*)



Conjunctive
(contradictory)

Individual
(independent)

Disjunctive
(partial)

(17) Who can chair the committee?
(*w: Only Andy and Billy can chair the committee; single-chair only.*)

$\Diamond[Of(a) \wedge Of(b)]$ — **Conjunctive** (contradictory)

$\Diamond Of(a) \quad \vee \quad \Diamond Of(b)$ — **Individual** (independent)

$\Diamond[Of(a) \vee Of(b)]$ — **Disjunctive** (partial)

Predictions

- **Mention-some = mention-one:**
  - Individual answers are all potentially max-inf.
  - Conjunctive and disjunctive answers cannot be max-inf.
- **$\Diamond$-modal licenses MS:**
  The O-operator makes the individual answers logically independent; the presence of the $\Diamond$-modal makes them not mutually exclusive.

Deriving mention-all

(18) Who can chair the committee?
(*w: only Andy and Billy can chair the committee; single-chair only.*)

a. Andy.\
b. Andy and Billy.\
c. Andy or Billy.\

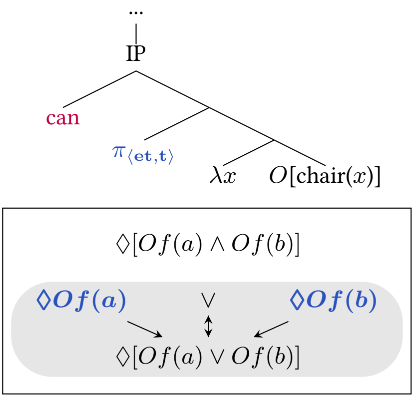
Two ways of getting MA (Xiang 2016: chapter 2)

- **Conjunctive MA:**
  The higher-order *wh*-trace scopes over the $\Diamond$-modal.
- **Disjunctive MA:**
  A DOU-operator ($\approx$ the Mandarin FC-licensing particle *dou*) is associated with the higher-order *wh*-trace.

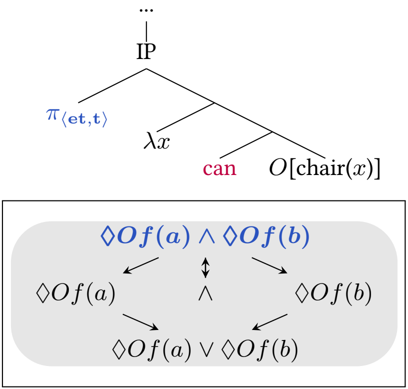
Deriving conjunctive mention-all

(19) 'Who can chair the committee?' 'Andy and Billy.\'

When $\pi \gg \Diamond$: conjunctions take wide scope, yielding conjunctive MA.



$\Diamond \gg \pi$: MS



$\pi \gg \Diamond$: Conjunctive MA

Deriving disjunctive mention-all

(20) “Who can chair the committee?” “Andy or Billy.\”

Disjunctive MA arises in the presence of a DOU-operator (≈ Mandarin *dou*).

- Associating *dou* with a pre-verbal disjunction yields a **free choice** inference.

  (21) [Yuehan **huozhe** Mali] **dou** keyi jiao jichu hanyu
  John or Mary DOU can teach intro Chinese
  Intended: ‘Both John and Mary can teach Intro Chinese.’ (FC)

- In questions, associating *dou* with the *wh*-phrase forces **exhaustive** readings.

  (22) **Dou** [**shei**] keyi jiao jichu hanyu?
  DOU who can teach Intro Chinese
  ‘Who can teach Intro Chinese?’ (MA only)

Deriving disjunctive mention-all

Xiang (2016b, To appear): *dou* is a pre-exhaustification exhaustifier over sub-alternatives. Sub-alternatives for dis/con-junctions and the dis/con-juncts.

(23) $[\![dou_C]\!] = \lambda p \lambda w : \exists q \in \textsc{Sub}(p, C).$
$$p(w) = 1 \wedge \forall q \in \textsc{Sub}(p, C)[O_C(q)(w) = 0]$$

a. Presupposes the existence of a sub-alternative.

b. Affirms the prejacent, and negates the exhaustification of each sub-alt.

Getting the FCI-licenser use: (Cf. Fox 2007 and Chierchia 2013 on deriving FC)

(24) [John or Mary] **dou** can teach Intro Chinese.

a. $p = \Diamond f(j) \vee \Diamond f(m)$

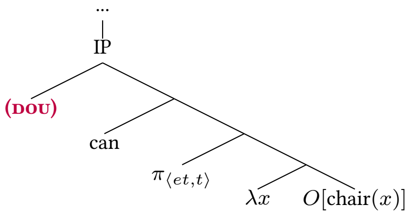
b. $\textsc{Sub}(p, C) = \{\Diamond f(j), \Diamond f(m)\}$

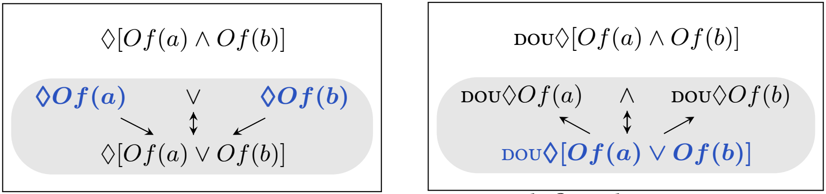
c. $[\![dou_C]\!](p) = [\Diamond f(j) \vee \Diamond f(m)] \wedge \neg O_C \Diamond f(j) \wedge \neg O_C \Diamond f(m)$
(*j* or *m* can teach $\wedge$ not only *j* can teach $\wedge$ not only *m* can teach)
$= \Diamond f(j) \wedge \Diamond f(m)$
(*j* can teach **and** *m* can teach)

[This analysis also extends to other uses of *dou*, such as the distributor use, the *even*-like use.]

(25) “Who can chair the committee?” “Andy or Billy.\”

Disjunctive MA arises when a **DOU-operator** is associated with the higher-order *wh*-trace across the ◊-modal: it strengthens disjunctive answers into **FC** inferences.





Without O_{DOU}: MS

With O_{DOU}: disjunctive MA

Summarizing Completeness

Completeness = Max-informativity

(26) Jenny knows Q.
$\rightsquigarrow$ Jenny knows a max-informative true answer of Q.

a. $\lambda w.\exists \phi \in \textsc{Ans}([\![Q]\!])(w)[\textit{know}_w(j, \phi)]$

b. $\textsc{Ans}([\![Q]\!])(w) = \{p \mid w \in p \in Q \wedge \forall q[w \in q \in Q \rightarrow q \not\subset p]\}$

Mention-some

- MS- and MA-answers are uniformly possibly complete/max-inf answers.
- MS is always mention-one and is primarily licensed by a $\Diamond$-modal.
- MS/MA ambiguity is from minimal structural variations within the Q-nucleus.

Part II. Sensitivity to false answers

Plan

1. Two facts of FA-sensitivity
2. The exhaustification-based approach and its problems
3. Characterizing FA-sensitivity

Facts about FA-sensitivity (I)

The most prominent reading of indirect MA-questions is **Weak Exhaustivity + FA-sensitivity**, called "intermediately exhaustive". (Cremers & Chemla 2016)

"... knows who came."

Did ... come?	*a*	*b*	*c*	
Facts	✓	✓	✗	
Jenny's belief	✓	✓	?	☺
Sue's belief	✓	✓	✓	☹

Indirect MS-questions are also subject to FA-sensitivity. (George 2013)

"... knows where we can buy an Italian newspaper."

INs are available at ...	*Newstopia?*	*PaperWorld?*	
Facts	✓	✗	
John's belief	✓	?	☺
Mary's belief	✓	✓	☹

Fact 1: $\Rightarrow$ FA-sensitivity shall be derived uniformly for both MA and MS questions.

Facts about FA-sensitivity (II)

Fact 2: FA-sensitivity is concerned with all types of false answers, including those that are always **partial**.

(27) Who came?

a. Andy or Billy. $\phi_a \vee \phi_b$
b. Andy didn't. $\neg\phi_a$

False disjunctives: $\phi_b \vee \phi_c$

(28) Jenny knows [who came]. FALSE

Fact: *a* came, but *bc* didn't.
J's belief: *a* and someone else came, **who might be *b* or *c***.

False denials: $\neg\phi_c$

Italian papers are available at ...	*A?*	*B?*	*C?*	
Facts	✓	✗	✓	
Mary's belief	✓	✓	?	**over-affirming (OA)**
Sue's belief	✓	?	✗	**over-denying (OD)**

(29) **Sue** knows where one can buy an Italian newspaper. FALSE ≫ TRUE

The exhaustification-based approach

Intermediately exhaustive readings

1. The ordinary value of an indirect question is its **Completeness** Condition.
2. **FA-sensitivity** is derived by **exhaustifying** Completeness.
   (Klinedinst & Rothschild 2011, Uegaki 2015, Cremers 2016, Theiler et al 2018)

(30) ***O*** [$_S$ Jenny knows [$_Q$ who came]] (*w: ab came, but c didn't.*)

a. $[\![S]\!] = \lambda w.\exists\phi \in \textsc{Ans}([\![Q]\!])(w)[know_w(j,\phi)] = know(j, \phi_{a\oplus b})$
   (J knows a **true** complete answer of Q.)

b. $\mathcal{A}lt(S) = \{\lambda w.\exists\phi \in \textsc{Ans}([\![Q]\!])(\boldsymbol{w'})[bel_w(j,\phi)] \mid w' \in W\}$

$$= \left\{ \begin{array}{lll} bel(j,\phi_a) & bel(j,\phi_{a\oplus b}) & bel(j,\phi_{a\oplus b\oplus c}) \\ bel(j,\phi_b) & bel(j,\phi_{b\oplus c}) & \\ bel(j,\phi_c) & bel(j,\phi_{a\oplus c}) & \end{array} \right\}$$

   ({J believes ϕ | ϕ is a **possible** complete answer of Q})

c. $[\![O(S)]\!] = know(j,\phi_{a\oplus b}) \wedge \neg bel(j,\phi_c)$
   (J **only** believes the **TRUE** complete answer of Q.)

The exhaustification-based approach

Extending to MS-questions

Using **innocent exclusion**, global exhaustification yields an inference close to FA-sensitivity. (D. Fox and A. Cremers p.c. independently)

(31) O_{IE} [$_{\text{S}}$ Jenny knows [$_{\text{Q}}$ where we can get gas]] (*w: ab sell gas, but c doesn't.*)

a. $[\![\text{S}]\!] = \lambda w.\exists\phi \in \textsc{Ans}([\![\text{Q}]\!])(w)[\mathit{know}_w(j,\phi)]$
$= \mathit{know}(j,\phi_a) \vee \mathit{know}(j,\phi_b)$

b. $\mathcal{A}lt(\text{S}) = \{\lambda w.\exists\phi \in \textsc{Ans}([\![\text{Q}]\!])(\boldsymbol{w'})[\mathit{bel}_w(j,\phi)] \mid w' \in W\}$

$$= \left\{ \begin{array}{lll} \mathit{bel}(j,\phi_a), & \mathit{bel}(j,\phi_a) \vee \mathit{bel}(j,\phi_b), & \ldots \\ \mathit{bel}(j,\phi_b), & \mathit{bel}(j,\phi_a) \vee \mathit{bel}(j,\phi_c), & \\ \mathit{bel}(j,\phi_c), & \mathit{bel}(j,\phi_b) \vee \mathit{bel}(j,\phi_c), & \end{array} \right\}$$

c. $[\![O_{\text{IE}}(\text{S})]\!] = [\mathit{know}(j,\phi_a) \vee \mathit{know}(j,\phi_b)] \wedge \neg \mathit{bel}(j,\phi_c)$

Predictions of the exhaustification-based approach

1. FA-sensitivity is a **scalar implicature** of Completeness.
2. FA-sensitivity is only concerned about answers that are **potentially complete**.

Problems with the exhaustification-based approach (I)

Empirically: FA-sensitivity inferences do not behave like scalar implicatures.

- FA-sensitivity is **not cancelable**.

(32) a. Did Mary invite some of the speakers to the dinner?
b. Yes. **Actually she invited all of them.**

(33) (w: *Andy and Billy presented this morning, Cindy didn't.*)
a. Does Mary know which speakers presented this morning?
b. Yes. **#Actually she believes that *abc* all did.**

- FA-sensitivity inferences are easily generated even in **downward-entailing** environments.

(34) If Mary invited some of the speakers to the dinner, I will buy her a coffee.
$\not\rightsquigarrow$ If M invited some **but not all** speakers to the dinner, I will...

(35) If Mary knows which speakers presented this morning, I will ...
$\rightsquigarrow$ If [M knows *ab* presented] $\wedge$ **not [M believes *c* presented]**, I will...

Problems with the exhaustification-based approach (I)

- FA-sensitivity inferences are not "mandatory" scalar implicatures: (36a) evokes an **indirect** scalar implicature, while (37a) doesn't.

(36) a. Mary **only** did **not** invite the JUNIOR$_F$ speakers to the dinner.
$\rightsquigarrow$ Mary invited the senior speakers to the dinner. ϕ_{senior}

b. $\boldsymbol{O}\ \neg\phi_{\text{junior}} = \neg\phi_{\text{junior}} \wedge \neg\neg\phi_{\text{senior}} = \neg\phi_{\text{junior}} \wedge \phi_{\text{senior}}$

(37) (w: *Andy and Billy presented this morning, Cindy didn't.*)

a. Mary does **not** know which speakers presented this morning.
$\not\rightsquigarrow$ Mary believes that Cindy presented this morning $bel(m, \phi_c)$

b. $\boldsymbol{O}$ **not** [Mary knows which speakers presented this morning]

Problems with the exhaustification-based approach (II)

Recall: FA-sensitivity is concerned about **all types of false answers**, not just those that are potentially complete.

Technically: To obtain the desired FA-sensitivity inference via exhaustification, we need a very special alternative set.

(38) $\boldsymbol{O}_{\text{IE}}$ [$_{\text{S}}$ Jenny knows where we can get gas] (w: *ab sell gas, but cd do not.*)

a. $[\![\text{S}]\!] = \textit{know}(j, \phi_a) \vee \textit{know}(j, \phi_b)$

b. $\mathcal{A}lt(\text{S}) = \left\{ \begin{array}{ll} \textit{bel}(j, \phi_c), \textit{bel}(j, \phi_d), \ldots & \text{Over-affirming} \\ \textit{bel}(j, \neg\phi_a), \textit{bel}(j, \neg\phi_b), \ldots & \text{Over-denying} \\ \textit{bel}(j, \phi_c \vee \phi_d), \ldots & \text{Disjunctive} \\ \ldots & \\ \sout{\textit{bel}(j, \phi_a \wedge \phi_b)}\ldots & \sout{\text{Mention-all/few}} \end{array} \right\}$

Characterizing FA-sensitivity

Taking stock

- FA-sensitivity is seen in both indirect MA-questions and MS-questions.
- FA-sensitivity is asserted, not implicated.
- FA-sensitivity is concerned with all types of false answers.

(39) Jenny knows Q.

a. **Completeness**
$\lambda w.\exists \phi \in \textsc{Ans}([\![Q]\!])(w)[\textit{know}_w(j, \phi)]$
(Jenny **knows** a max-informative true answer of Q.)

b. **FA-sensitivity**
$\lambda w.\forall \phi \in \textsc{Rel}([\![Q]\!])[w \notin \phi \rightarrow \neg \textit{believe}_w(j, \phi)]$
(Jenny doesn't **believe** any **Q-relevant** false answers.)

Remaining issues:

1. What is **Q-relevance**?
2. Why is **factivity** preserved in Completeness but discarded in FA-sensitivity?

(40) **Q-relevance**
$\textsc{Rel}(\llbracket Q \rrbracket) = \{\bigcup X \mid X \subseteq \textsc{Part}(\llbracket Q \rrbracket)\}$
(ϕ is Q-relevant iff ϕ is a union of some partition cells of Q.)

(41) Who came?

a. $\phi_a \vee \phi_b = c_1 \cup c_2 \cup c_3$
b. $\neg\phi_a = c_3 \cup c_4$

c_1	w: both of *ab* came in w
c_2	w: only *a* came in w
c_3	w: only *b* came in w
c_4	w: neither of *ab* came in w

Q-relevance

Various ways to define partition:

- Based on the **equivalence of true** answers:
  $\textsc{Part}([\![\mathrm{Q}]\!]) = \{\lambda w[Q_w = Q_{w'}] \mid w' \in W\}$
- Based on the **equivalence of complete true** answers:
  $\textsc{Part}([\![\mathrm{Q}]\!]) = \{\lambda w[\textsc{Ans}([\![\mathrm{Q}]\!])(w) = \textsc{Ans}([\![\mathrm{Q}]\!])(w')] \mid w' \in W\}$

Who came?

w: $Q_w = \{\phi_a, \phi_b, \phi_{a\oplus b}\}$
w: $Q_w = \{\phi_a\}$
w: $Q_w = \{\phi_b\}$
w: $Q_w = \varnothing$

=

w: both *ab* came$_w$
w: only *a* came$_w$
w: only *b* came$_w$
w: neither came$_w$

=

w: $\textsc{Ans}([\![\mathrm{Q}]\!])(w) = \{\phi_{a\oplus b}\}$
w: $\textsc{Ans}([\![\mathrm{Q}]\!])(w) = \{\phi_a\}$
w: $\textsc{Ans}([\![\mathrm{Q}]\!])(w) = \{\phi_b\}$
w: $\textsc{Ans}([\![\mathrm{Q}]\!])(w) = \varnothing$

Where can we get gas?

w: $Q_w = \{\Diamond\phi_a, \Diamond\phi_b, \Diamond\phi_{a\vee b}\}$
w: $Q_w = \{\Diamond\phi_a, \Diamond\phi_{a\vee b}\}$
w: $Q_w = \{\Diamond\phi_b, \Diamond\phi_{a\vee b}\}$
w: $Q_w = \varnothing$

=

w: both ab sell$_w$ gas
w: only a sells$_w$ gas
w: only b sells$_w$ gas
w: neither sells$_w$ gas

=

w: $\textsc{Ans}([\![\mathrm{Q}]\!])(w) = \{\Diamond\phi_a, \Diamond\phi_b\}$
w: $\textsc{Ans}([\![\mathrm{Q}]\!])(w) = \{\phi_a\}$
w: $\textsc{Ans}([\![\mathrm{Q}]\!])(w) = \{\phi_b\}$
w: $\textsc{Ans}([\![\mathrm{Q}]\!])(w) = \varnothing$

Q-relevance

To get the partition, **knowing Q** cannot be reduced to **knowing one answer of Q.**

(42) Jenny knows [$\textsc{Ans}_w$ who came] ✗

Feasible options to define the embedded question:

(43) Jenny knows [$_{\textbf{Partition}}$ who came] ✓
Jenny knows [$_{\textbf{Hamblin set}}$ who came] ✓
Jenny knows [$_{\textbf{Property}}$ who came] ✓
Jenny knows [λw $\textsc{Ans}_w$ [who came]] ✓

Factivity and FA-sensitivity: Facts

1. **For cognitive factives and veridical communication verbs**:
   Factivity is preserved in Completeness but not in FA-sensitivity.

   (44) John **knows** who came. (*w: ab came, but c didn't.*)

   a. ⇝ John knows that a and b came.
   b. ⇝ John doesn't **believe**/#**know** that c came.

   (45) John **told** us who came.

   a. ⇝ John truthfully told us that a and b came.
   b. ⇝ John didn't **(#truthfully)** tell us that c came.

2. **For emotive factives**:
   Q-embeddings with emotive factives do not seem to be FA-sensitive.

   (46) John is **surprised** at who came.
   ⇝̸ #John isn't surprised that c came.

3. **Decl-embeddings** do not seem to be FA-sensitive.

   (47) John knows that a and b came.
   ⇝̸ John doesn't believe that c came.

Analysis: on cognitive factives

- Uegaki (2015, 2016): A cognitive factive involves a **non-factive** predicate and an **Ans**-operator. Its factivity comes from Ans.

(48) $[\![\text{know}]\!]^w = \lambda Q \lambda x.[\text{believe}_w(x, \textsc{Ans}(Q)(w))]$

- Adapting to my account:
  Factivity is from Ans and thus not seen in FA-sensitivity.

(49) $[\![\text{Andy knows Q}]\!]^w = 1$ iff

a. **Completeness**
$\exists p \in \textsc{Ans}([\![\text{Q}]\!])(w)[\text{believe}_w(a, p)]$
(Andy **believes** a complete **true** answer of Q.)

b. **FA-sensitivity**
$\forall q \in \textsc{Rel}([\![\text{Q}]\!])[\text{believe}_w(a, q) \rightarrow q(w) = 1]$
(Every Q-relevant proposition that Andy **believes** is true.)

[This treatment extends to veridical communication verbs.]

Analysis: on emotive factives

- The emotive factive *surprise* is **factive** in lexicon. **Locally accommodating** the factive presupposition makes FA-sensitivity a **tautology**.

(50) $[\![\text{Andy is surprised at Q}]\!]^w = 1$ iff

a. **Completeness**
$\exists p \in \textsc{Ans}([\![Q]\!])(w)[p(w) = 1 \wedge \mathsf{surprise}_w(a, p)]$
(A complete true answer of Q ~~is true and~~ surprises a.)

b. **FA-sensitivity** = **tautology**
$\forall q \in \textsc{Rel}([\![Q]\!])[[q(w) = 1 \wedge \mathsf{surprise}_w(a, q)] \to q(w) = 1]$
(For every Q-relevant q: if q is true and it surprises a, then q is true.)

- Note: Global accommodation makes FA-sensitivity a **contradiction**.

b′. $\forall q \in \textsc{Rel}([\![Q]\!])[q(w) = 1 \wedge [\mathsf{surprise}_w(x, q) \to q(w) = 1]]$
(For every Q-relevant q: q is true and [if p surprises x, then q is true.)

Analysis: on decl-embeddings

Declarative-embeddings do not seem to be subject to FA-sensitivity.

- The **Decl-to-Q reduction** approach (Uegaki 2015, 2016):
  Factives uniformly select for a **Q-denotation**; declarative complements must be shifted into Q-denotations.

(51) a. If questions are proposition sets:
$\textsc{shift}(p_{st}) = \{p\}$
b. If questions are functions (of type $\langle \tau, st \rangle$):
$\textsc{shift}(p_{st}) = \lambda q_{st} : q = p.q$

- The only Q-relevant propositions of a declarative are **this declarative itself and its negation**. FA-sensitivity collapses under Completeness/Factivity.

(52) $[\![a \text{ knows S}]\!]^w = 1$ iff
a. $\exists p \in \underbrace{\textsc{Ans}(\textsc{shift}([\![\text{S}]\!]))(w)}_{\{[\![\text{S}]\!]\}/\varnothing}[\text{believe}_w(a, p)]$ **Completeness**
$\Downarrow$
b. $\forall q \in \underbrace{\textsc{Rel}(\textsc{shift}([\![\text{S}]\!]))}_{\{[\![\text{S}]\!], \neg[\![\text{S}]\!]\}}[\text{believe}_w(a, q) \rightarrow q(w) = 1]$ **FA-sensitivity**

Summarizing FA-sensitivity

- **Content**
  FA-sensitivity is much stronger than what it has been thought to be. It is concerned with all the Q-relevant propositions, including those that are always partial.
- **Derivation**
  Q-relevant propositions are uniformly derived from the partition of Q. Hence, embedded questions must be able to supply partitions.
- **Factivity**
  - Cognitive factives are not factive per se. Their factivity is from Ans and hence not seen in FA-sensitivity.
  - Emotive factives are truly factive. Locally accommodating their factivity makes the FA-sensitivity condition a tautology.

Conclusions

Question-embeddings are subject to Completeness and FA-sensitivity. I argue that these conditions should NOT be understood as exhaustiveness/exhaustivity.

- **Completeness is weaker than Exhaustiveness**
  MS-answers, while being non-exhaustive, can serve as complete answers of MS questions.
- **FA-sensitivity is not derived from exhaustification**
  FA-sensitivity is asserted and is concerned with all the Q-relevant propositions.

Thank You!

With the same conversational goal, presence of ◊-modal significantly increases the acceptance of MS. (Xiang & Cremers 2017)

Scenario: Mary is in charge of choosing two children to lead the dance. The only rule is that the children leading the dance should have an accessory in common.

How children are dressed:

Ann Bill Chloe Diana

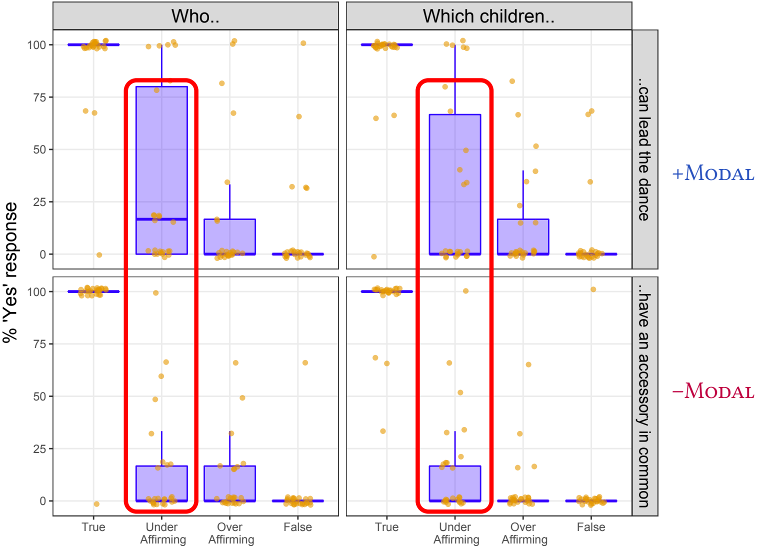
Mary's memory:

Bill and Chloe wear the same bow tie, Chloe wears a hat.
Therefore, Bill and Chloe can lead the dance.

Sentences: ±D-LINKED ±MODAL

Mary remembers { who / which children } { can lead the dance / have accessaries in common }

Appendix: Xiang & Cremers (2017)



Mixed effect model on UA(=MS) targets reported a significant effect of Modal ($p < .001$).

☞ MS is more readily available with the presence of ◇-modal.

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