Sensitivity to false answers in question-embeddings[1]

1. Introduction

- **Intermediately exhaustive** (IE) readings are widely available in indirect mention-all (MA-)questions.

(1) John knows who came.

– Paraphrase 1: "only(WE)" (Klinedinst and Rothschild 2011, Uegaki 2015, a.o.)
WE + $\forall x$: if x didn't come, not [John $V\text{s}_{[-\text{VER}]}$ that x came].

– Paraphrase 2: "WE + FA-sensitivity" (Xiang 2016a,b)
WE + $\forall p$: if p is relevant to 'who came' and p is false, not [John $V\text{s}_{[-\text{VER}]}$ p]

- George (2011, 2013) interpretations of indirect mention-some (MS-)questions are also subject to **false answer (FA-)sensitivity**.

(2)

Italian newspapers are available at ...	*Newstopia?*	*PaperWorld?*
Facts	Yes	No
John's belief	Yes	?
Mary's belief	Yes	Yes

a. John knows where one can buy an Italian newspaper. [Judgment: TRUE]
b. Mary knows where one can buy an Italian newspaper. [Judgment: FALSE]

George takes this fact as an argument against the **reductive view** of question-embedding *know* (which says: x knows Q $\approx$ x knows a (complete true) answer of Q) — 'which answers of Q x knows' doesn't suffice to resolve 'whether x knows Q.'

2. The exhaustification-based approach and its problems

2.1. Klinedinst and Rothschild (2011)

- Core assumption: FA-sensitivity is a logical consequence of exhaustifying Completeness.

(3) a. John knows [who came] **WE**
b. EXH [John knows [who came]] **IE**

(4) $\text{EXH}(p) = \lambda w[p(w) = 1 \wedge \forall q \in \text{ALT}(p)[p \not\subseteq q \rightarrow q(w) = 0]]$
(The prejacent p is true, while the alternatives that are not entailed by the p are false.)

- Adapting K&R's account to a schema using answerhood-operators and regular exhaustification:

(5) EXH [$_{\text{S}}$ John knows [$_{\text{Q}}$ who came]]
(*w: Among the three considered individuals, Andy and Billy came, but Cindy didn't.*)

[1]This handout is based on Xiang (2016a) and Xiang (2016b: chapter 4).

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

b. $\textsc{Alt}(\text{S}) = \{\lambda w.\exists\phi \in \textsc{Ans}([\![\text{Q}]\!])(w')[\textsf{believe}_w(j,\phi)] \mid w' \in W\}$

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

({John believes ϕ | ϕ is a potential complete answer of Q})

c. $[\![\textsc{Exh}(\text{S})]\!] = \textsf{know}(j,\phi_{a\oplus b}) \wedge \neg\textsf{believe}(j,\phi_c)$ **IE**
(John only believes the TRUE complete answer of Q.)

2.2. Extending the exhaustification-based account to indirect MS questions

- Two options:

(6) John knows [$_\text{Q}$ where we can get gas].
a. $\exists\phi$ [ϕ is a true MS answer of Q] [EXH [John knows ϕ]] **Local exhaustification**
b. EXH [$\exists\phi$ [ϕ is a true MS answer of Q] [John knows ϕ]] **Global exhaustification**

- Local exhaustification is clearly too strong. Consider: what truth value is predicted by the option of local exhaustification?

Can we get gas from ...?	A	B	C	D
Fact	Yes	Yes	Yes	No
John's belief	Yes	Yes	?	No

- Using innocent exclusion, global exhaustification yields an inference that is very close to the FA-sensitivity condition.[2] Innocent exclusion doesn't negate propositions of the form "John believes ϕ" where ϕ is a true MS answer or a disjunctive answer that involves at least one true MS answer as a disjunct. (Danny Fox and Alexandre Cremers p.c.)

(8) John knows [$_\text{Q}$ where we can get gas].
(*w: Among the considered places abc, only a and b sell gas.*)
a. IE-EXH [$_\text{S}$ $\exists\phi$ [ϕ is a true MS answer of Q] [John knows ϕ]]
b. $[\![\text{S}]\!] = \lambda w.\exists\phi \in \textsc{Ans}([\![\text{Q}]\!])(w)[\textsf{know}_w(j,\phi)] = \textsf{know}(j,\phi_a) \vee \textsf{know}(j,\phi_b)$
c. $\textsc{Alt}(\text{S}) = \{\lambda w.\exists\phi \in \textsc{Ans}([\![\text{Q}]\!])(w')[\textsf{believe}_w(j,\phi)] \mid w' \in W\}$

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

d. $[\![\text{IE-Exh(S)}]\!] = [\textsf{know}(j,\phi_a) \vee \textsf{know}(j,\phi_b)] \wedge \neg\textsf{believe}(j,\phi_c)$

[2] Roughly, innocently excludable alternatives are alternatives that can always be negated consistently.

(7) **Innocent Exclusion** (Fox 2007)
a. *Innocently excludable alternatives*
$\text{IE}\textsc{xcl}(p,C) = \bigcap\{A \mid A \text{ is a maximal subset of } C \text{ s.t. } \{\neg q \mid q \in A\} \cup \{p\} \text{ is consistent}\}$
(The intersection of the maximal sets of alternatives in C such that the exclusion of each such set is consistent with p)
b. *Innocently exclusive exhaustifier*
$\text{IE-E}\textsc{xh}_C(p) = \lambda w[p(w) = 1 \wedge \forall q \in \text{IE}\textsc{xcl}(p,C)[q(w) = 0]]$
(The prejacent p is true, and the innocently excludable alternatives of p are false.)

2.3. Problems with the exhaustification-based account

- **Problem 1: FA-sensitivity doesn't behave like a scalar implicature**

1. FA-sensitivity inferences are **not cancelable**.

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

(10) (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.**

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

(11) 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...

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

3. FA-sensitivity inferences are not "mandatory" scalar implicatures: (13b) evokes an **indirect** scalar implicature, while (14b) doesn't.

(13) a. Mary **only** invited the JUNIOR$_F$ speakers to the dinner.
    $\rightsquigarrow$ Mary did not invite the senior speakers to the dinner. $\neg\phi_{\text{senior}}$
    b. Mary **only** did **not** invite the JUNIOR$_F$ speakers to the dinner.
    $\rightsquigarrow$ Mary invited the senior speakers to the dinner. ϕ_{senior}
    b′. $\text{EXH}\ \neg\phi_{\text{junior}} = \neg\phi_{\text{junior}} \wedge \neg\neg\phi_{\text{senior}} = \neg\phi_{\text{junior}} \wedge \phi_{\text{senior}}$

(14) (w: *Andy and Billy presented this morning, Cindy didn't.*)
    a. Mary knows which speakers presented this morning.
    $\rightsquigarrow$ not [Mary believes that Cindy presented this morning] $\neg\mathsf{bel}(\mathsf{m}, \phi_{\mathsf{c}})$
    b. Mary does **not** know which speakers presented this morning.
    $\not\rightsquigarrow$ Mary believes that Cindy presented this morning $\mathsf{bel}(\mathsf{m}, \phi_{\mathsf{c}})$
    b′. EXH **not** [Mary knows which speakers presented this morning]

- **Problem 2: FA-sensitivity is also concerned with partial answers**

  The exhaustification-based account considers only the answers that are potentially complete. But FA-sensitivity condition is concerned with all types of false answers, including also those that can never be complete:

(15) Who came?
    a. Andy or Billy. $\phi_a \vee \phi_b$ Disjunctive partial
    b. Andy didn't. $\neg\phi_a$ Negative partial

– **False disjunctives**

(16) John knows who came. [Judgment: FALSE]
    Fact: *a* came, while *b* and *c* didn't come.
    John's belief: *a* someone else came, <u>who might be *b* or *c*.</u>

(17) John knows where we can get gas. [Judgment: FALSE]
Fact: *a* sells gas, while *b* and *c* do not.
John's belief: *a* and somewhere else sell gas, which might be *b* or *c*.

– **False denials** (over-denying)

(18)

Italian newspaper are available at ...	*A?*	*B?*	*C?*	FA-type
Facts	Yes	No	Yes	
John's belief	Yes	?	?	
Mary's belief	Yes	**Yes**	?	OA
Sue's belief	Yes	?	**No**	OD

a. John knows where one can buy an Italian newspaper. TRUE
b. Sue knows where one can buy an Italian newspaper. FALSE > TRUE

– To derive the desired FA-sensitivity inference, an exhaustification-based account would have to assume a very special set of alternatives.

(19) John knows where we can get gas.
(w : *Among the four considered places, a and b sell gas; but c and d do not.*)
a. IE-Exh [$_S$ John knows [$_Q$ where we can get gas]]
b. $[\![S]\!] = \textsf{know}(j, \phi_a) \vee \textsf{know}(j, \phi_b)$
c. No feasible way to generate an alternative set as follows:

$$\textsc{Alt}(S) = \left\{ \begin{array}{ll} \textsf{bel}(j,\phi_c), \textsf{bel}(j,\phi_d), ... & \text{OA} \\ \textsf{bel}(j,\neg\phi_a), \textsf{bel}(j,\neg\phi_b), ... & \text{OD} \\ \textsf{bel}(j,\phi_c \vee \phi_d), ... & \text{Disj} \\ ... & \\ \sout{\textsf{bel}(j,\phi_a \wedge \phi_b), \textsf{bel}(j,\phi_{a\oplus b})} ... & \sout{\text{MA/MI}} \end{array} \right\}$$

3. Re-analyzing FA-sensitivity (Xiang 2016ab)

- Completeness and FA-sensitivity are two independent conditions. Both of them are mandatory.

(20) John know Q.
a. $\lambda w.\exists\phi \in \textsc{Ans}([\![Q]\!])(w)[\textsf{know}_w(j,\phi)]$ **Completeness**
(John knows a complete true answer of Q.)
b. $\lambda w.\forall\phi \in \textsc{Rel}([\![Q]\!])[w \notin \phi \rightarrow \neg\textsf{believe}_w(x,\phi)]$ **FA-sensitivity**
(John has no Q-relevant false belief.)

- Q-relevant propositions can be recovered from the partition of the embedded question.

(21) **Q-relevance propositions**
$\textsc{Rel}([\![Q]\!]) = \{\bigcup X : X \subseteq \textsc{Par}([\![Q]\!])\}$
(ϕ is Q-relevant if and only if ϕ is the union of some partition cells of Q.)

(22) **Partitions**
a. If Q denotes a Hamblin set Q:
$\textsc{Par}([\![Q]\!]) = \{\lambda w[Q_w = Q_{w'}] : w' \in W\}$, where $Q_w = \{p : w \in p \in Q\}$
(The family of world sets s.t. every world in each world set yields the same true propositional answers)

b. If Q denotes a topical property **P**:
$\textsc{Par}([\![Q]\!]) = \{\lambda w[\mathbf{P}_w = \mathbf{P}_{w'}] : w' \in W\}$, where $\mathbf{P}_w = \{\alpha : \alpha \in \text{Dom}(\mathbf{P}) \wedge w \in \mathbf{P}(\alpha)\}$
(The family of world sets s.t. every world in each world set yields the same true short answers)

Example:

(23) John knows [$_Q$ who came]

a. $Q = \{\hat{}\mathsf{came}(x) \mid x \in \mathsf{people}_{@}\}$

b. $\mathbf{P} = \lambda x[\mathsf{people}_{@}(x) = 1.\hat{}\mathsf{came}(x)\}$

c. Andy came. $\phi_a = c_1 \cup c_2$
Andy or Billy came. $\phi_a \vee \phi_b = c_1 \cup c_2 \cup c_3$
Andy didn't. $\neg\phi_a = c_3 \cup c_4$

Partition 1					Partition 2
w: $Q_w = \{\phi_a, \phi_b, \phi_{ab}\}$		c_1	w: only ab came$_w$		w: $\mathbf{P}_w = \{a, b, a \oplus b\}$
w: $Q_w = \{\phi_a\}$	=	c_2	w: only a came$_w$	=	w: $\mathbf{P}_w = \{a\}$
w: $Q_w = \{\phi_b\}$		c_3	w: only b came$_w$		w: $\mathbf{P}_w = \{b\}$
w: $Q_w = \varnothing$		c_4	w: nobody came$_w$		w: $\mathbf{P}_w = \varnothing$

Discussion: In each of the following LFs, are we able to recover the Q-relevant propositions from embedded question?

(24) a. John knows [$\textsc{Ans}_w$ [$_Q$ who came]]

b. John knows [λw [$\textsc{Ans}_w$ [$_Q$ who came]]]

4. FA-sensitivity and factivity (new!)

- **Fact 1:** In paraphrasing FA-sensitivity, a factive has to be replaced with its non-factive counterpart.

(25) (*w: Among the three considered individuals, Andy and Billy came, but Cindy didn't.*)

a. John knows who came.
$\not\rightsquigarrow$ John doesn't **know** that c came.
$\rightsquigarrow$ John doesn't **believe** that c came.

- **Fact 2:** Emotive factives do not seem to be FA-sensitive.

(26) John is surprised at who came.
$\Leftrightarrow \exists\phi$ [ϕ is a true answer as to *who came*] [John is surprised at ϕ]
$\not\rightsquigarrow$ John isn't surprised that c came.

- I incorporate my section 3 on FA-sensitivity into Uegaki's proposition-to-question reduction approach to capture these two facts and unify FA-sensitivity readings across mention-some and mention-all questions. Main assumptions are:[3]

  1. A questions denotes a topical property ($\mathbf{P}$ of type $\langle \tau, st \rangle$); $\textsc{Ans}(\mathbf{P})(w)$ returns the set of complete true propositional answers of this question in w.

     (27) a. $$\textsc{Ans}^{S}(\mathbf{P})(w) = \left\{ \alpha \;\middle|\; \begin{array}{l} \alpha \in \mathrm{Dom}(\mathbf{P}) \wedge w \in \mathbf{P}(\alpha) \wedge \\ \quad \forall \beta \in \mathrm{Dom}(\mathbf{P})[w \in \mathbf{P}(\beta) \rightarrow \mathbf{P}(\alpha) \subseteq \mathbf{P}(\beta)] \end{array} \right\}$$

     b. $$\textsc{Ans}(\mathbf{P})(w) = \{\mathbf{P}(\alpha) \mid \alpha \in \textsc{Ans}^{S}(\mathbf{P})(w)\}$$

  3. FA-sensitivity is concerned with all types of false propositions relevant to the embedded question. These propositions are formed out of the partition of this question.

     (28) $\textsc{Par}(\mathbf{P}) = \{\lambda w[\mathbf{P}_w = \mathbf{P}_{w'}] \mid w' \in W\}$, where $\mathbf{P}_w = \{\alpha \mid \alpha \in \mathrm{Dom}(\mathbf{P}) \wedge w \in \mathbf{P}(\alpha)\}$

  3. Factivity:

     a. Cognitive factives and veridical communication verbs are not factive *per se*; the factivity in Completeness comes from the $\textsc{Ans}$-operator. (Uegaki 2015, 2016)

     b. In contrast, emotive factives (e.g. *surprise*) are factive in lexicon; this factivity makes the FA-sensitivity condition a tautology.

- **Q-embedding factives**

– Q-embedding *know* (NB: know is not factive — it's rather understood as believe)

(29) $$[\![\text{know}]\!]^{w_0} = \lambda \mathbf{P}_{\langle \tau, st \rangle}.\lambda x_e.\ \underbrace{\exists p \in \textsc{Ans}(\mathbf{P})(w_0)[\mathsf{know}_{w_0}(x,p)]}_{\text{Completeness}} \wedge \underbrace{\forall q \in \{\bigcup X \mid X \subseteq \textsc{Par}(\mathbf{P})\}[\mathsf{know}_{w_0}(x,q) \rightarrow q(w_0) = 1]}_{\text{FA-sensitivity}}$$

(x believes a complete true answer of Q_P; every Q_P-relevant proposition x believes is true.)

– Q-embedding *surprise* (NB: surprise is factive)
Locally accommodating the factive presupposition of *surprise* makes FA-sensitivity a tautology.

(30) $$[\![\text{surprise}]\!]^{w_0} = \lambda \mathbf{P}_{\langle \tau, st \rangle}.\lambda x_e.\ \underbrace{\exists p \in \textsc{Ans}(\mathbf{P})(w_0)[p(w_0) = 1 \wedge \mathsf{surprise}_{w_0}(x,p)]}_{\text{Completeness}} \wedge \underbrace{\forall q \in \{\bigcup X \mid X \subseteq \textsc{Par}(\mathbf{P})\}[[q(w_0) = 1 \wedge \mathsf{surprise}_{w_0}(x,q)] \rightarrow q(w_0) = 1]}_{\text{FA-sensitivity = tautology}}$$

Discussion: what inferences would be derived if the factive presupposition of *surprise* is accommodated globally?

(31) $$\ldots \forall q \in \{\bigcup X \mid X \subseteq \textsc{Par}(\mathbf{P})\}[q(w_0) = 1 \wedge [\mathsf{surprise}_{w_0}(x,q) \rightarrow q(w_0) = 1]]$$

[3] Assumptions 1 and 2 can also be altered to be compatible with Hamblin-Karttunen Semantics. But, assuming a categorial approach makes it easier to capture QV-effects in questions with a non-divisive collective predicate. (Xiang 2016, 2018; Cremers 2018)

- **Declarative-embedding factives**

  (32) x knows that John came.

  Since a factive is lexically encoded with an ANS-operator, which has to combine with a topical property (of type $\langle \tau, st \rangle$), a proposition-denoting declarative complement has to be type-shifted into a function of type $\langle st, st \rangle$.

  (33) $\textsc{shift}(p) = \lambda q : q = p.q$

  Discussion: Unpack $\textsc{Par}(\textsc{shift}(\hat{}\,\mathsf{came}(j)))$ and define (32) using the schema in (29). You shall observe that now FA-sensitivity collapses under Completeness.

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