Sensitivity to false answers

1. Question embedding predicates

- **Rogative**
  - \{ask, depend on, wonder, ...\}

- **Responsive**
  - **Veridical**
    - \{be certain, tell[^ver], agree, ...\}
  - **Non-veridical**
    - \{prove, be clear, ...\}

- **Factive**
  - \{know, be surprised, tell[^ver], ...\}
- **Non-factive**
  - \{prove, be clear, ...\}

**Factives**

a. Cognitive factives: know, remember, discover, ...

b. Emotive factives: be surprised, be pleased, be annoyed, ...

c. Communication verbs: tell, predict, ...

- Responsive vs. rogative: whether a predicate can take declarative complements

  (1) a. John knows that Mary left.
  b. * John asked me that Mary left.

- Veridical vs. non-veridical

  (2) a. John knows who left.
    \[\rightsquigarrow \text{For some true answer } p \text{ as to who left, John knows } p.\]
  b. John is certain about who left.
    \[\rightsquigarrow \text{For some possible answer } p \text{ as to who left, John is certain about } p.\]

**Communication verbs as factives**

Karttunen (1977): *tell* is non-veridical w.r.t. declarative complements, but it can be veridical w.r.t. interrogative complements; hence, the veridicality of interrogative-embedding *tell* comes from the interrogative complement.

(3) a. John told us that Mary left. \[\rightsquigarrow \text{Mary left.}\]
  b. John told us who left. \[\rightsquigarrow \text{For some true answer } p \text{ as to who came, John told us } p.\]
Spector & Egré (2015): declarative-embedding *tell* does admit a factive/veridical reading; hence, the veridicality of interrogative-embedding *tell* comes from *tell*, not the interrogative complement.

(4) a. Sue didn’t tell Jack that Fred is the culprit.  

b. Did Sue tell Jack that Fred is the culprit?  

2. Facts of sensitivity to false answers

2.1. Sensitivity to false answers in indirect mention-all questions

- Weak/strong/intermediate exhaustivity

(5) John knows who came.  

(\textit{w: Among the three considered individuals, Andy and Billy came, but Cindy didn’t.})

a. John knows that \(a\) and \(b\) came. \hspace{1cm} \text{WE}

b. John knows that \(a\) and \(b\) came; and John knows that \(c\) did \textbf{not} come. \hspace{1cm} \text{SE}

c. John knows that \(a\) and \(b\) came; and \textbf{not} [John believes that \(c\) came]. \hspace{1cm} \text{IE}

- The condition that distinguishes IE from WE is called “sensitivity to false answers” (FA-sensitivity).

- WE is too weak:

(6) John knows which numbers between 10 and 20 are prime. \hspace{1cm} \text{(J. Higginbotham)}

(\textit{FALSE} if John believes that all numbers between 10 and 20 are prime.)

- IE is widely available:

Cremers & Chemla (2016) experimentally validate the existence of IE for *know* and *predict*.

Exceptions: emotive factives do not seem to license IE readings.

(7) John is surprised at who came. \iff \hspace{1cm} John is surprised that \(a\) and \(b\) came. \hspace{1cm} \rightarrow \hspace{1cm} John isn’t surprised that \(c\) came.

2.2. Sensitivity to false answers in indirect mention-some questions

- George (2011, 2013): indirect MS-questions also have readings sensitive to false answers, in parallel to IE readings of indirect MA-questions.

(8) \begin{tabular}{l|cc}
\textbf{Italian newspapers are available at ...} & \textbf{Newstopia?} & \textbf{PaperWorld?} \\
\hline
\textbf{Facts} & \text{Yes} & \text{No} \\
John’s belief & \text{Yes} & \text{?} \\
Mary’s belief & \text{Yes} & \text{Yes} \\
\end{tabular}

a. John knows where one can buy an Italian newspaper. \hspace{1cm} \text{[Judgment: TRUE]}  
b. Mary knows where one can buy an Italian newspaper. \hspace{1cm} \text{[Judgment: FALSE]}
3. The exhaustification-based approach and its problems


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

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

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

<table>
<thead>
<tr>
<th>Can we get gas from ...?</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fact</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>John’s belief</td>
<td>Yes</td>
<td>Yes</td>
<td>?</td>
<td>No</td>
</tr>
</tbody>
</table>
• Using innocent exclusion, global exhaustification yields an inference that is very close to the FA-sensitivity condition.

[I don’t expect you to understand the definition now...] Roughly, innocently excludable alternatives are alternatives that can always be negated consistently.

(14) **Innocent Exclusion** (Fox 2007)

a. **INNOCENTLY EXCLUDABLE ALTERNATIVES**

\[ \text{IE-Excl}(p) = \bigcap \{ A : A \text{ is a maximal subset of } \text{ALT}(p) \text{ s.t. } A^- \cup \{p\} \text{ is consistent} \} \]

where \( A^- = \{ q : q \in A \} \)

(The intersection of the maximal sets of alternatives of \( p \) such that the exclusion of each such set is consistent with \( p \))

b. **INNOCENTLY EXCLUSIVE EXHAUSTIFIER**

\[ \text{IE-Exh}(p) = \lambda w. [p(w) = 1 \land \forall q \in \text{IE-Excl}(p)[q(w) = 0]] \]

(The prejacent \( p \) is true, and the innocently excludable alternatives of \( p \) are false.)

Using innocent exclusion avoids negating 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.

(15) John knows \[\square \text{ where we could get gas}\].

\( (w: \text{Among the considered places abc, only a and b sell gas.}) \)

a. **IE-Exh \[\square \exists \phi [\phi \text{ is a true MS answer of } Q] [\text{John knows } \phi] \]**

b. **[S] = \lambda w. \exists \phi [\phi \in \text{ANS}([Q])(w)[\text{know}_w(j, \phi)] = \text{know}(j, \phi_a) \lor \text{know}(j, \phi_b) \]**

c. \[\text{ALT}(S) = \{ \lambda w. \exists \phi [\phi \in \text{ANS}([Q])(w')[\text{believe}_w(j, \phi)] | w' \in W \} \]

\[= \left\{ \begin{array}{l}
\text{bel}(j, \phi_a), \quad \text{bel}(j, \phi_a) \lor \text{bel}(j, \phi_b), \quad \text{bel}(j, \phi_a) \lor \text{bel}(j, \phi_b) \lor \text{bel}(j, \phi_c) \\
\text{bel}(j, \phi_b), \quad \text{bel}(j, \phi_a) \lor \text{bel}(j, \phi_c), \\
\text{bel}(j, \phi_c), \quad \text{bel}(j, \phi_b) \lor \text{bel}(j, \phi_c) \end{array} \right\} \]

d. **[IE-Exh(S)] = [\text{know}(j, \phi_a) \lor \text{know}(j, \phi_b)] \land \neg \text{believe}(j, \phi_c) \]**
3.3. Problems with the exhaustification-based account

Problem 1: FA-sensitivity doesn’t behave like a scalar implicature (skipped. See Xiang 2016: §4.4.3.2)

Problem 2: FA-sensitivity is 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:

(16) Who came?
   a. Andy or Billy. \( \phi_a \lor \phi_b \) Disjunctive partial
   b. Andy didn’t. \( \neg \phi_a \) Negative partial

- False disjunctives

(17) John knows who came. [Judgment: FALSE]
   Fact: a came, while b and c didn’t come.
   John’s belief: a someone else came, who might be b or c.

(18) 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)

(19) 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.

(20) 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. \([S] = \text{know}(j, \phi_a) \lor \text{know}(j, \phi_b) \)
   c. No way to generate an alternative set as follows:

\[
\text{ALT}(S) = \begin{cases} 
\text{bel}(j, \phi_c), \text{bel}(j, \phi_d), \ldots & \text{OA} \\
\text{bel}(j, \neg \phi_a), \text{bel}(j, \neg \phi_b), \ldots & \text{OD} \\
\text{bel}(j, \phi_c \lor \phi_d), \ldots & \text{Disj} \\
\text{...} \\
\text{bel}(j, \phi_a \lor \phi_b), \text{bel}(j, \phi_{a\lor b}), \ldots & \text{MA/MI} 
\end{cases}
\]
4. An alternative approach (Xiang 2016)

4.1. Getting FA-sensitivity

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

\begin{align*}
\text{(21)} & \quad \text{John know } Q. \\
& \quad \text{Completeness} \\
& \quad \lambda w. \exists \phi \in \text{ANS}(\llbracket Q \rrbracket) \left[ \text{know}_w(j, \phi) \right] \\
& \quad \text{(John knows a complete true answer of } Q) \\
& \quad \lambda w. \forall \phi \in \text{REL}(\llbracket Q \rrbracket) \left[ w \notin \phi \rightarrow \neg \text{believe}_w(x, \phi) \right] \\
& \quad \text{FA-sensitivity} \\
& \quad \text{(John has no } Q\text{-relevant false belief.)}
\end{align*}

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

\begin{align*}
\text{(22)} & \quad \text{REL}(\llbracket Q \rrbracket) = \{ \bigcup X : X \subseteq \text{PAR}(\llbracket Q \rrbracket) \} \\
& \quad (\phi \text{ is } Q\text{-relevant if and only if } \phi \text{ is the union of some partition cells of } Q) \\
\text{(23)} & \quad \text{Partitions} \\
& \quad a. \text{ If } Q \text{ denotes a Hamblin set } S:\n
\quad \text{PAR}(\llbracket Q \rrbracket) = \{ \lambda w[Q_w = Q_{w'}] : w' \in W \}, \text{ where } Q_w = \{ p : w \in p \in Q \} \\
\quad (\text{The family of world sets s.t. every world in each world set yields the same true propositional answers}) \\
& \quad b. \text{ If } Q \text{ denotes a topical property } P:\n
\quad \text{PAR}(\llbracket Q \rrbracket) = \{ \lambda w[P_w = P_{w'}] : w' \in W \}, \text{ where } P_w = \{ \alpha : \alpha \in \text{Dom}(P) \land w \in P(\alpha) \} \\
\quad (\text{The family of world sets s.t. every world in each world set yields the same true short answers})
\end{align*}

\text{Example:}

\begin{align*}
\text{(24)} & \quad \text{John knows } [Q \text{ who came}] \\
& \quad a. \quad Q = \{ ^* \text{ came}(x) : x_e \in ^* \text{people}_a \} \\
& \quad b. \quad P = \lambda x_e[ ^* \text{people}_a(x) = 1. ^* \text{ came}(x)] \\
& \quad c. \quad \text{Andy came.} \\
& \quad \text{Andy or Billy came.} \\
& \quad \text{Andy didn’t.}
\end{align*}

\begin{align*}
\text{Partition 1} & \quad \text{Partition 2} \\
\begin{array}{cccc}
\text{w: } & Q_w = \{ \phi_a, \phi_b, \phi_{ab} \} & \text{c1: } & w: \text{ only } ab \text{ came}_w \\
\text{w: } & Q_w = \{ \phi_a \} & \text{c2: } & w: \text{ only } a \text{ came}_w \\
\text{w: } & Q_w = \{ \phi_b \} & \text{c3: } & w: \text{ only } b \text{ came}_w \\
\text{w: } & Q_w = \emptyset & \text{c4: } & w: \text{ nobody came}_w \\
\end{array}
\end{align*}

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

\begin{align*}
\text{(25)} & \quad a. \quad \text{John knows } [\text{ANS}_w [Q \text{ who came}]] \\
& \quad b. \quad \text{John knows } [\lambda w [\text{ANS}_w [Q \text{ who came}]]]
\end{align*}
4.2. FA-sensitivity and factivity

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

  (26) *(w: Among the three considered individuals, Andy and Billy came, but Cindy didn’t.)*
  
  a. John knows who came.
  
  \[ \downarrow \top \top \Downarrow \text{John doesn’t know that } c \text{ came.} \]
  
  \[ \Downarrow \text{John doesn’t believe that } c \text{ came.} \]

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

  (27) John is surprised at who came.
  
  \[ \Leftrightarrow \exists \phi [ \phi \text{ is a true answer as to who came } ] [ \text{John is surprised at } \phi ] \]
  
  \[ \Downarrow \text{John isn’t surprised that } c \text{ came.} \]

- **Explaining Fact 1:** Accommodating a factive presupposition makes FA-sensitivity suffer presupposition failure or be tautologous. Hence, in paraphrasing FA-sensitivity, the factive presupposition of know needs to be “deactivated.”

  (28) FA-sensitivity condition for ‘John knows Q’:
  
  a. **GLOBAL ACCOMMODATION \times**
  
  \[ \lambda w. \forall \phi \in \text{REL([Q])} [ w \notin \phi \rightarrow [ w \in \phi \land \neg \text{believe}_w(j, \phi)] ] \]
  
  *(For any Q-relevant proposition \( \phi \), whenever \( \phi \) is false, \( \phi \) is true and it is not the case that John believe \( \phi \).)*
  
  **Contradiction**

  b. **LOCAL ACCOMMODATION \times**
  
  \[ \lambda w. \forall \phi \in \text{REL([Q])} [ w \notin \phi \rightarrow \neg [ w \in \phi \land \text{believe}_w(j, \phi)] ] \]
  
  *(For any Q-relevant proposition \( \phi \), whenever \( \phi \) is false, then it is not the case that \( \phi \) is true and John believes \( \phi \).)*
  
  **Tautology**

  c. **DEACTIVATING FACTIVITY \sqrt{ }**
  
  \[ \lambda w. \forall \phi \in \text{REL([Q])} [ w \notin \phi \rightarrow \neg \text{believe}_w(j, \phi)] \]
  
  *(For any Q-relevant proposition \( \phi \), if \( \phi \) is false, then John doesn’t believe \( \phi \).)*

- **Explaining fact 2:**

  Emotive factives are strong presupposition triggers.

  (29) a. If someone **regrets** that I was mistaken, I will admit that I was wrong.
  
  \[ \Downarrow \top \top \Downarrow \text{The speaker was mistaken.} \]

  b. If someone **discovers** that I was mistaken, I will admit that I was wrong.
  
  \[ \Downarrow \text{The speaker was mistaken.} \]

  Their factive presuppositions cannot be deactivated and must be locally accommodated. Locally accommodating the factive presupposition turns the FA-sensitivity condition into a tautology.

  (30) FA-sensitivity condition for ‘John is surprised at Q’:
  
  \[ \lambda w. \forall \phi \in \text{REL([Q])} [ w \notin \phi \rightarrow \neg [ w \in \phi \land \text{surprise}_w(j, \phi)] ] \]
  
  *(For any Q-relevant proposition, whenever \( \phi \) is false, it is not the case that \( \phi \) is true and John is surprised at \( \phi \).)*
  
  **Tautology**