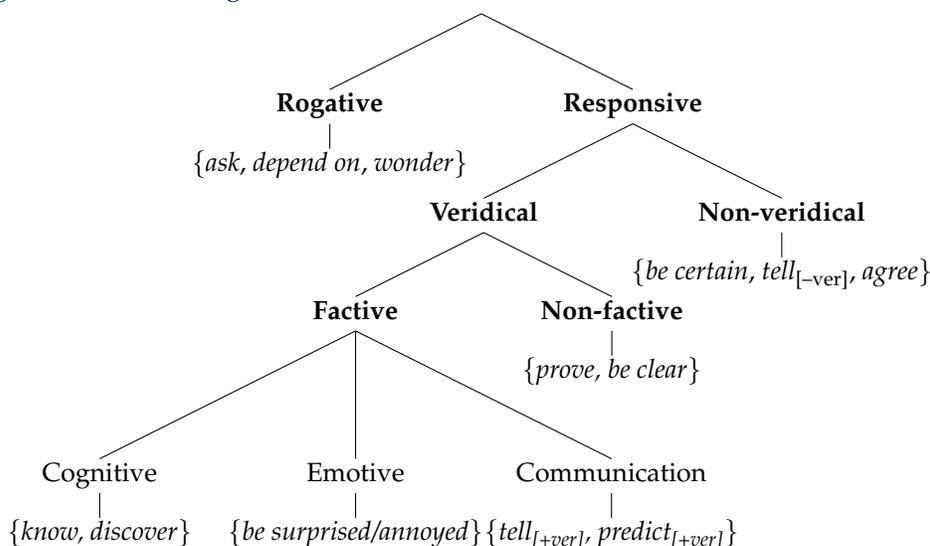# Question-embeddings and strength of exhaustivity

1. Question-embedding predicates

- The typology of question-embedding predicates (adapted from (Lahiri 2002: chap. 6), Spector and Egré (2015), and Uegaki (2015)):

```
                              _____|_____
                             |                       |
                        Rogative                 Responsive
                            |                    ____|____
                  {ask, depend on, wonder}      |         |
                                            Veridical  Non-veridical
                                            ___|___          |
                                           |       |   {be certain, tell[−ver], agree}
                                        Factive  Non-factive
                                     _____|_____       |
                                    |     |     |  {prove, be clear}
                                    |     |     |
                               Cognitive Emotive Communication
                                  |        |        |
                            {know, discover} {be surprised/annoyed} {tell[+ver], predict[+ver]}
```

- 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: whether the attitude is held towards a true answer of the question

(2) a. John knows who left.
         ⤳ *For a __true__ answer p as to who left, John knows p.*
     b. John is certain about who left.
         ⤳ *For a __possible__ answer p as to who left, John is certain about p.*

- Veridical ⇏ Factive (Egré 2008, Uegaki 2015)

(3) a. John proved which academic degree he has.
         ⤳ *For some true answer p as to which academic degree John has, John proved p.*
     b. John proved that he has a PhD.
         ⤳ *John has a PhD.*
     c. John didn't prove that he has a PhD.
         ⇏ *John has a PhD.*   (Uegaki 2015: chap. 4)

- A note on 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 question-embedding *tell* comes from the interrogative complement.

(4)   a. John told us that Mary left. $\not\leadsto$ *Mary left.*
       b. John told us who left. $\leadsto$ *For some true answer p as to who came, John told us p.*

Spector and 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.

(5)   a. Sue didn't tell Jack that Fred is the culprit. $\leadsto$ *Fred is the culprit.*
       b. Did Sue tell Jack that Fred is the culprit? $\leadsto$ *Fred is the culprit.*

2. Variation of exhaustivity

2.1. Three forms of exhaustivity

- Earlier works notice two types of exhaustive readings in question-embeddings, i.e., **weak exhaustivity** (WE) (Karttunen 1977) and **strong exhaustivity** (SE) (Groenendijk and Stokhof 1982, 1984).

(6)   John Vs who came.   [V: a question-embedding predicate]
       a. $\forall x$: if x came, John Vs that x came.   **WE**
       b. WE + $\forall x$: if x didn't come, John Vs that x didn't come.   **SE**

- Recent works are more focused on an intermediate form of exhaustive readings. There are two ways to paraphrase **intermediately exhaustive** (IE) readings:

  - Paraphrase 1: "only(WE)" (Klinedinst and Rothschild 2011, Uegaki 2015, a.o.)
    WE + $\forall x$: if x didn't come, not [John Vs$_{[-\text{VER}]}$ that x came].
  - Paraphrase 2: "WE + No-false-belief" (Xiang 2016: chapter 4)
    WE + $\forall p$: if p is relevant to 'who came' and p is false, not [John Vs$_{[-\text{VER}]}$ p]

Propositions relevant to 'who came' include not only propositions of the form 'x came', but also those derived via iterated applications of Boolean operations (disjunction, conjunction, complement) to those propositions.

Xiang's paraphrase predicts the sensitivity to false partial answers:

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

2.2. Distribution

- It is commonly believed that SE readings are licensed by cognitive factives but are difficult for other veridical responsive predicates. (Gr&S, a.o.) But, Cremers and Chemla (2016) found experimental evidence for the availability of SE readings with the communication verb *predict*.

- Two views on the distribution of WE readings:

  1. WE readings can be licensed by most veridical predicates except cognitive factives. (Gr&S 1984, George 2011, Uegaki 2015)

  2. WE readings are also available under cognitive factives. (Karttunen 1977, Heim 1994, Guerzoni and Sharvit 2007, a.o.)

     (8)   Jack knows who came, but he does not know who did not come.

A possible confusion: the reading claimed to be WE in those works might be actually **intermediately exhaustive** (IE) (Lahiri 2002: 149)

   (9)   John knows which numbers between 10 and 20 are prime.   (J. Higginbotham)
         (FALSE if John believes that all numbers between 10 and 20 are prime.)

- IE readings are widely available (C&C 2016). Emotive factives are the only seeming exceptions. However, the unavailability of IE readings with emotive factives seem to be related to the infelicity of the false answer (FA-)sensitivity inference itself.

   (10)   John is surprised at who came.
          $\not\leadsto$ #$\forall x$: if x didn't come, John isn't surprised that x came.
          $\not\leadsto$ #$\forall p$: if p is false and p is relevant to 'who came', John isn't surprised at p.

2.3. Ways to derive the WE/SE contrast

- **Selection of answerhood** (Heim 1994, Dayal 1996, Beck and Rullmann 1999)

   (11)   a. $\text{ANS}_{\text{WE}}(Q)(w) = \iota p[w \in p \in Q \land \forall q[w \in q \in Q \to p \subseteq q]]$ (Dayal 1996)
          b. $\text{ANS}_{\text{SE}}(Q)(w) = \lambda w'[\text{ANS}_{\text{WE}}(Q)(w) = \text{ANS}_{\text{WE}}(Q)(w')]$ (Heim 1994)
               (The set of worlds w' s.t. the question has the same WE answer(s) in w and w'.)

[NB: We've seen several definitions for WE-answerhood, by Heim, Dayal, and Fox. The choice of WE-answerhood doesn't matter for the definition of SE-answerhood.]

- **Strengthening operation**: A strengthening operation can be optionally applied to the question root (George 2011, Klinedinst and Rothschild 2011) or within the question nucleus (Nicolae 2013, 2015).

- **Neg-raising**: Uegaki (2015: chap. 3) makes use of global exhaustification to derive IE readings (*à la* Klinedinst and Rothschild 2011) and further derives SE readings from IE readings via neg-raising.

2.4. Ways to derive IE/ FA-sensitive readings (Next week)

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