Exhaustivity and question embedding II

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K&R 2011

Below is the mechanics we used for question semantics and exhaustivity in original version of paper, and is essentially what Uegaki 2015 uses. No reason I can see to prefer it to the alternatives* approach from published paper, but serves as useful point of comparison on more interesting, general issues.

*nb.: Although we spoke of alternatives as 'F'-values we explicitly did not equate them to focus values (p.11).

Basic questions semantics

(1) a. $[\![\text{Who came}]\!]^{w,v} = \lambda w'.\ \forall x(x \text{ came in } v \rightarrow x \text{ came in } w')$
b. $[\![\text{John came}]\!]^{w,v} = \text{True iff John came in } w$

Note also that unlike in final version of our paper, semantic values of declaratives are world relative.

2nd world parameter plays no role except for (embedded) questions: assume that when a sentence is evaluated globally w.r.t. world w, v gets set to w.

Metasemantics/pragmatics:

- The answer to question q as evaluated in world w is $[\![q]\!]^{w,w}$
- The asserted content of declarative d (in w) is $[\![d]\!]^{w,w}$.

Example.

(2) Suppose we have just 3 individuals John, Bill and Mary, and only Bill came in v and only Mary in w. Then,
a. $[\![\text{who came}]\!]^{w,v} = \lambda w'.$ John came in w'
i.e. Karttunen answer (K-denotation) in v
b. $[\![\text{who came}]\!]^{w,w} = \lambda w'.$ Mary came in w'
i.e. Karttunen answer (K-denotation) in w

Exhaustive interpretation

Recall that a main idea of paper was identifying and capturing Intermediately Exhaustive reading. We took a flexible approach in doing this, defining an operator that yields Strongly Exhaustive (=G&S) reading for embedded questions when applied locally to embedded question, IE reading when applied globally.

Non-application gives Karttunen's reading or 'Weak Exhaustivity' as this is basic semantics of questions. In paper, we were not explicit about obligatoriness of EXH, mostly because of uncertainty about the data. We return to this issue below.

SE reading with embedded EXH

For simplicity let's define two EXH's rather than one of flexible type (as in paper). Question version here, propositional below:

(3) $[\![\text{EXH } \phi]\!]^{w,v} =$

$$\lambda w'.\ \begin{cases} [\![\phi]\!]^{w,w}(w') = \text{True} \\ [\![\phi]\!]^{w,u}(w') = \text{False}, \\ \quad \text{for all } u \text{ s.t. } [\![\phi]\!]^{w,u} \subset [\![\phi]\!]^{w,w} \end{cases}$$

(4) $[\![\text{EXH who came}]\!]^{w,v} =$

$$\lambda w'.\ \begin{cases} [\![\text{who came}]\!]^{w,w}(w') = \text{True} \\ [\![\text{who came}]\!]^{w,u}(w') = \text{False}, \\ \quad \text{for all } u \text{ s.t. } [\![\text{who came}]\!]^{w,u} \subset [\![\text{who came}]\!]^{w,w} \end{cases}$$

"proposition true in a world w' iff...

$$\begin{cases} \text{The Karttunen answer in } w \text{ is true in } w' \\ \text{The Kartunnen answer in } u \text{ is false in } w', \\ \quad \text{for any } u \text{ in which the K-answer in } u \text{ is stronger} \\ \quad \text{than the K-answer in } w \text{ is} \end{cases}$$ "

This is just the G&S, = Strongly Exhaustive answer.

Note that the work done by the 2nd world parameter is to let us compute different possible Karttunen answers (and negate stronger ones). In the published version this work was done by "F" values of questions, which we equated with possible Karttunen answers.

With Q = EXH who came, and following semantics, we derive G&S's SE reading for 'know who came':

(5) $[\![\text{x knows S}]\!]^{w,v}$ = True iff John knows in w the proposition $[\![\text{S}]\!]^{w,w}$

Nb. with S = who came, we get the WE exhaustive reading.

Declarative complements

In principle we can treat question and declarative embedding verbs as the same lexical item, e.g. use semantics in (5) for declaratives. Let's assume 'that' yields a proposition:

(6) $[\![\text{that d}]\!]^{w,v} = \lambda w'.\ [\![\text{d}]\!]^{w',v}$ = True
e.g. $[\![\text{that John}]\!]^{w,w}$
$= \lambda w'.\ [\![\text{John came}]\!]^{w',w'}$ = True
$= \lambda w'.$ John came in w'

To deal with factive presupposition of 'know' using truth value gaps, further assume for (5) that

(7) $[\![\text{x knows S}]\!]^{w,v} = \#$ unless $[\![\text{S}]\!]^{w,w}(w)$ = True

Note that this is trivial where S is a question, Q, since $[\![\text{Q}]\!]^{w,w}$ is by definition true in w.

IE reading with matrix EXH

(8) John predicted who came.
IE reading: John predicted true answer, did not make any false predictions

Matrix/type t EXH: (obvious similarities to (3) but I spare you a unified flexible type defintion)

(9) $[\![\text{EXH}_p\ \phi]\!]^{w,v} =$

$$\text{True iff} \begin{cases} [\![\phi]\!]^{w,w} = T\text{rue} \\ w \in \{w' : [\![\phi]\!]^{w',u} = F\}, \\ \quad \text{for all } u \text{ s.t. } \{w' : [\![\phi]\!]^{w',u} = T\} \subset \{w' : [\![\phi]\!]^{w',w} = T\} \end{cases}$$

(10) $[\![\text{John predicted Q}]\!]^{w,v}$ = True iff John predicted in w the proposition $[\![\text{Q}]\!]^{w,w}$

(11) $[\![\text{EXH John predicted Q}]\!]^{w,v} =$

$$\text{True iff} \begin{cases} [\![\text{John predicted who came}]\!]^{w,w} = T \\ w \notin \{w' : [\![\text{John predicted who came}]\!]^{w',u} = T\}, \\ \text{for all } u \text{ s.t. } \{w' : [\![\text{John pred. who came}]\!]^{w',u} = T\} \subset \\ \{w' : [\![\text{John predicted who came}]\!]^{w',w} = T\} \end{cases}$$

$$\text{“John} \begin{cases} \text{predicted that p, p = the K-answer in } w \\ \text{did not predict any } p' \text{ which is the K-answer in} \\ \qquad \text{some other world and is stronger than } p \end{cases} \text{”}$$

Issues arising

Boring technical

One reason we used our alternatives based system was because it would get messy to get correct predictions with multiple embeddings. Suppose only Mary came, and only Bill predicted that Mary came.

(12) John predicted who predicted who came.
   a. John's prediction: Bill will predict Mary will come.
   b. John's prediction: Bill will predict who will come.

Given that (12) is true in (b) we need more (and arbitrary) indices and assumptions to avoid “passing down” the evaluation world to multiply embedded questions. Implementation is ugly; Uegaki dodges some of that ugliness, since he uses world variables in syntax (in ad hoc way for embedded questions) rather than additional parameter(s). But it amounts to exactly the same thing.

Factivity (and veridicality)

(11) only captures the IE reading on the assumption that ‘predict’ *in the sense at hand* is *non-factive*: that is, that for John to predict some proposition, does not entail that proposition to be true. Otherwise, the exhaustivity requirement can at most be vacuous and we don't get the “no false predictions” entailment.

In and of itself this is not a problem, at least on purely semantic grounds, as on them there is no way to show that ‘predict wh’ *is* factive. And notice that there is not only a factive, but also non-factive use ‘predict that’:

(13) John predicted that Trump would win, Bill that Hilary would.

Section 5 of our paper discusses the issue of factivity explicitly for the case of ‘know’. Here, however, we took factivity for granted – and further that ‘know wh’ is the same or defined in terms of ‘know that’, which would appear to be factive. Given this, we expected no IE reading for ‘know’.

We were unsure about the facts but it turns out that that IE readings are robust for ‘know’ (Cremers & Chemla 2014).

In anticipation of this we pointed out in section 5 that IE readings could be derived by lexical decomposition of ‘know’.

In fact this is probably the right move for ‘predict’, even, for at least two reasons:

Ellipsis and coordination:

(14)
   a. John knows who came but not that it is raining.
   b. John predicted who won the election, but not that she would start a war with Iran.

(15) John knows who came and that the party was lame.
(15) John predicted who won and that she would start a war.

Factivity and veridicality:

As we'll discuss next time, there may be a generalisation that all veridical verbs have factive counterparts. Treating them as the same verb would be a nice way to capture that.

Decomposing 'know' lexically

Notice that 'know that' is trivially "factive" given a trivalent semantics: for then if 'know that p' is true, or false, its complement is. On the other hand this means we can't conclude much from the entailment from 'know that p' to p: it might be wholly due to the presupposition.

That is we might have a "non-factive" semantics: one might conceivably replace 'know' with a (clearly) non-factive attitude in the metalanguage definition (5). Given (7) it still follows that we have one 'know', that 'know that p' entails p, and that 'know who came' entails knowing a true answer. But one can stand in the "know" relation to a false proposition (and as such, IE readings can be derived straightforwardly).

Is this a plausible view of 'know'? Don't ask an epistemologist.

Other factives

Another class of factive/veridical verbs ("emotive" factives) including 'surprise', 'be happy', etc., seem, unlike 'know', to only have clearly detectable WE and SE readings.

(16) Bill and Mary came, but not Tom.
John is surprised who came.
appears not to suggest anything like (a) (or (b))?
   a. ¬John expected [would have been surprised if] Bill, Mary and Tom to come.
   b. ¬John expected [would have been surprised if] Mary/Bill to come.
   *IE (?) (Spector and Egre 2015)

(17) John is surprised who didn't came, but not surprised who did come.
WE (Heim 1994)

(18) Three students run a race: Bob, Ted, Alice, and Sue. Emily expects Bod, Ted and Alice to run it in under 6 minutes. Only Bob runs it in under 6 min. Emily is surprised who ran the race in under 6 minutes (since she expected more people to).
SE (K&R 2011)

In discussion with Spector and Egre we observed that this pattern may make sense (if EXH is optional) given that 'surprise' type verbs are non-monotonic. This would explain the apparent lack of IE reading for e.g. 'John is surprised who came'.

(19) a. Bill has social anxiety.
John is surprised that Bill came to the party, but he is not surprised that Bill came and hid in the corner.
   b. John is surprised that Bill and Mary came to the party, but not surprised that Mary came.

Plausibly then even, with lexical decomposition, none of the "alternatives" to the proposition that John is surprised that p, p the actual answer to who came, is logically stronger (or weaker) and so matrix exhaustification of 'John is surprised who came' is vacuous given our def. of EXH as negating stronger "alternatives".

Summary

Putting aside the mechanics of exhaustifying, here is picture that is consistent with K&R 2011.

- Flexible application of EXH*
- Lexical decomposition of factives to get IE readings,
- but applying EXH in matrix is vacuous with 'surprise'-class verbs, hence no IE reading

*Perhaps with preference for application, and in matrix. Cremers and Chemla report preference for IE above all else, even for 'know'.

The seems compatible with possibility that WE is (strongly?) preferred to SE reading for 'surprise' type verbs, since matrix application is vacuous/collapses to WE.

Uegaki 2015 (Ch.3)

Uses a formal system closer to above to derive exhaustivity rather than alternatives. Let's put this aside since it's not very interesting. Both views introduce specific formal machinery to get the IE reading.

Implements (in a structural way) our suggestion about lexical decomposition to derive IE readings for factives.

The differences from K&R, then, are the following proposals:

- Only matrix application of EXH
- SE reading to be explained away, by an excluded middle presuppositions.

Since Uegaki assumes, as above, that 'surprise' type predicates are non-monotonic and thus matrix EXH is vacuous, he must deny that 'surprise' type predicates allow SE readings. (Well actually he says something more complicated but it looks dubious).

This is a first problem with his view (see also Cremers and Chemla to appear, who found further evidence for SE readings with 'surprise').

There are more issues but let's first look at decomposition and SE readings via excluded middle.

Lexical decomposition

Note initially there is a (not very relevant) decomposition of Karttunen semantics to "the true [Hamblin answer]"

(20) a. $[\![\text{who came}]\!]^{w,v} = \lambda p.\ \exists x(p = [\lambda w'.x \text{ came in } w'])$
i.e. (char. function of) set of Hamblin answers
b. $[\![\text{ANS Q}]\!]^{w,v} = \lambda w'.\ \forall p \in [\![Q]\!]^{w,v}\big(p(v) \rightarrow p(w')\big)$
= (1-a), i.e. the Karttunen answer in v

(U. further adds an existential presupposition to ANS that some member of the set it takes as argument is true in v, and assumes that it can also apply to declarative complements, which denote a singleton set of a proposition. This gives correct presupposition, like our lexical entry (5) + (7), for both 'know wh' and 'know that'.)

Here is the analysis of 'know', in essence:

(21) $[\![\text{x knows S}]\!]^{w,v}$ = True iff John "believes" in w the proposition $[\![\text{S}]\!]^{w,w}$

(Let's put aside Gettier problems / non-reducibility arguments about knowledge.).

Assuming that 'know' must combine combine with a clause headed by ANS (say for type reasons) this gives factivity of 'know that' and veridicality of 'know wh'.

But applying matrix EXH is now non-trivial since "believes" is non-factive: the stronger alternatives correspond to propositions of the form 'John believes that p', where p is a possible Karttunen answer.

SE as IE + excluded middle

U adds to (21) an "excluded middle" presupposition that

(22) $[\![\text{x knows S}]\!]^{w,v} = \#$ unless either John "believes" in w the proposition $[\![\text{S}]\!]^{w,w}$, or John believes $\neg[\![\text{S}]\!]^{w,w}$

With this presupposition, the IE reading strengthens to SE.

Putting aside some formal details of presupposition (projection), this is because exhaustifying 'John knows who came' adds to John knowing of person who came that he came, for each of the stronger possible K-answers, it is false that John knows [in (22) sense] it. But then by (22), he must further believe that it is false. That means he believes of everyone who didn't come that they didn't come.

There are lots of issues here.

(1) IE reading is according to Cremers and Chemla, the preferred one for many speakers.

(2) 'not know who came' does not imply having false beliefs about who came. (It may sometimes imply a total lack of true belief, but that's weaker and a problem for everyone).

(3) Another, major problem is that 'know that' does not behave in accord with (22): 'not know that' definitely does not imply "believing" that not. The cop don't know that Daniel smokes weed. But he might well be on their list of people to investigate.

(4) And that's a problem even if one responds to (1) by treating (22) as a contextual assumption rather than encoded presupposition.

Looks like we're better off with the flexible approach (though you may prefer U.'s semantics and like his way of decomposing factivity.)