Quantifying over the resolution

Overview. An adverb of quantification in the matrix clause can interact with the embedded question. This has been studied under the name of **Q**uantificational **V**ariability **E**ffects of embedded questions. This talk shows the standard QVE theories are empirically inadequate, as they fail to predict any sensitivity to false answers in the QV reading. I thus motivate a new approach to QVE, one in which the adverb modifies the resolution of the embedded question.

Empirical motivation. Two most influential theories on QVE are insensitive to false answers. The QV reading of *John mostly knows who called* is rendered as quantification over individuals who are the true short answers to the embedded question (1), or over the true propositional answers (2).

(1) $\textsf{most}\, x$ [x called] [John knows that x called] $\rightsquigarrow$ Berman (1991)

(2) $\textsf{most}\, p$ [Ans $(p,\ [\![\text{who called}]\!], w) \wedge p(w)$] [John knows p]
where w is the true world, Ans $(p, Q, w) = 1$ iff $p \in Q(w)$ $\rightsquigarrow$ Lahiri (2002)

Either way, the predicted truth conditions of the sentence can be paraphrased as follows: for most of the people who called, John knows that they called. It should follow, then, that the false beliefs John might have regarding the callers do not affect the truth of the sentence. To see why this is an implausible prediction, let's consider two scenarios (schematized in Appendix A). Suppose ten people might have called. We know that a, b, c, d actually called, the rest didn't. In scenario A, John says: " Only d didn't call." His beliefs about a, b, c that they called are correct, but he doesn't know that d also called and he wrongly believes that e to j called. In scenario B, John says: " a, b, c, e called." Here John also has correct beliefs about a, b, c; he is mistaken about d and e, but nobody else. Berman's and Lahiri's theories predict that *John mostly knows who called* holds true in both scenarios, because John knows three out of the four *true* answers. However, we sense a contrast between the two scenarios. In scenario A, asserting that John mostly knows who called seems infelicitous because his false beliefs are actually overwhelming. It becomes acceptable in scenario B, as John's false beliefs are minor in scenario B (cf. Groenendijk & Stokhof 1993 for similar data). Such a contrast suggests the embedded question is still sensitive to false answers in the QV reading; neither Berman nor Lahiri can account for that.

Proposal. In brief, QVE arises when there is a *resolution* of the answer to the embedded question. Such a resolution is part of the meaning of canonical QVE predicates like *know/tell/agree on*.

I assume the denotation of the embedded question is the Hamblin set, a set of propositions that are possible answers to the question. I propose to decompose canonical QVE predicates like *know/tell/agree on* into an attitude event (Hacquard 2010) and a resolution operator $\textsf{reso}$ that mediates between this attitude event and the denotation of the embedded question. $\textsf{reso}$ is defined as in (3); the function $\cap\textsf{CON}e$ in the definition is borrowed from Hacquard (2010): given an attitude event e, $\cap\textsf{CON}e$ retrieves the set of possible worlds that are compatible with that attitude event, by intersecting the propositional content of that event. κ is a placeholder for quantifiers that later saturate this position. The value of w is fixed by the verb (e.g. to *know* it is the true world).

(3) $\textsf{reso}_w := \lambda f \lambda Q \lambda \kappa \lambda e. fe \wedge \forall v \in (\cap\textsf{CON}e)\!: \kappa p[p \in Q \wedge pw][pv] \wedge \kappa p[p \in Q \wedge pv][pw]$
where w is the evaluation world of the resolution

$\textsf{reso}_w$ requires the answers taken to be true in the attitude event and the answers true in the evaluation world *overlap* to the degree κ: κ answers that are true in the evaluation world w are also true in any world v compatible with the attitude event, κ answers that are true in any attitude world v are also true in w. QVE arises when the adverb of quantification provides the quantifier that saturates κ. For a concrete example, decomposing *know* into a believing event and the resolution, the QV reading of *John mostly knows who called* comes out as (4) (the full derivation is in Appendix B):

(4) $\exists e\, \mathsf{belief}(e, \mathsf{john}) \wedge \forall v \in (\cap \mathsf{CON} e):$
$\mathsf{most}\, p\, [\, p \in [\![\text{who called}]\!] \wedge pw][pv] \wedge \mathsf{most}\, p\, [\, p \in [\![\text{who called}]\!] \wedge pv][pw]$

$\cap\mathsf{CON}e$ retrieves the set of worlds compatible with what John believes, his doxastic alternatives. The truth conditions of the QV reading, given (4), are (i) John knows most of the true answers and (ii) he has *few* false beliefs. (ii) successfully accounts for the difference between scenario A and B. In sum, we get false-answer sensitivity because unlike quantification over the true answers, modification on the resolution can be sensitive to false answers.

Some benefits: VERB SELECTION. My proposal predicts QVE is only possible when there is a resolution to the embedded question, where resolution requires settling the answer of the question in *some* evaluation world. This accounts for the observation that rogative verbs like *wonder/ask* normally don't license QVE: these verbs only select for question intensions, i.e., *functions* from a world to a true answer (Aloni & Roelofsen 2001), implying no settled answer, thus no resolution. STRONG EXHAUSTIVITY, without over-generation. My proposal implements strong exhaustivity with the resolution operator: modulo the involvement of events, reso saturated with a covert all is essentially equivalent to a bi-conditional entailment between the true answers and the attitude holder's beliefs (cf. the strong exhaustivity defined in Heim 1994, a.o.). There are some advantages compared to an available alternative theory for strong exhaustivity in QVE, namely Beck & Sharvit (2002). They define a Part operation that divides a question denotation into a set of subquestions; QVE comes from quantifying over the relevant subquestions. They also explicitly argue for strong exhaustivity in QVE. Details aside, in the strong exhaustive QV reading the relevant subquestions are a set of polar questions about each possible answer; the answers to these subquestions resolve the whole situation. This reading also differentiates scenario A and B, but it over-generates unattested QV readings. QVE with singular embedded *wh* (e.g., 5a) is unavailable, but the strong exhaustive reading of (5a) in their proposal is well-defined as (5b).

(5) a. # John partly/mostly knows which boy called.
b. $\mathsf{some/most}\, Q\ [\ Q \in \mathsf{Part}\ ([\![\text{which boy called}]\!])(w)\ ][\text{ John knows } Q\ ]$
where $\mathsf{Part}\ ([\![\text{which boy called}]\!])(w) = \{$Did Bill call? Did Nate call? ...$\}$
c. $\exists e\, \mathsf{belief}(e, \mathsf{john}) \wedge \forall v \in (\cap \mathsf{CON} e):$ $\underline{\mathsf{some/most}\, p\, [\, p \in [\![\text{which boy called}]\!] \wedge pw][pv] \wedge}$
$\underline{\mathsf{some/most}\, p\, [\, p \in [\![\text{which boy called}]\!]} \wedge pv][pw]$

The problem dissolves in my proposal: the strongly exhaustive reading of (5a) is (5c), the underlined part can't be fulfilled because singular *wh-* questions presuppose a singular true answer.

Conclusions. This talk presents a new approach to QVE that accounts for the possible false answer sensitivity in the QV reading. In my theory, the quantification of the adverb is not on individuals or true answers, but rather the resolution towards the true answers. The strong exhaustivity it derives is intricate enough to take account into the attitude holder's mental states rather than simply uncovering the whole situation; I have illustrated how this helps us avoid over-generation.

A Schematizing the example scenarios

The tables below give an intuitive sketch of the two scenarios I use to illustrate the possible false answer sensitivity in QVE. T and F stand for "true" and "false".

Scenario A

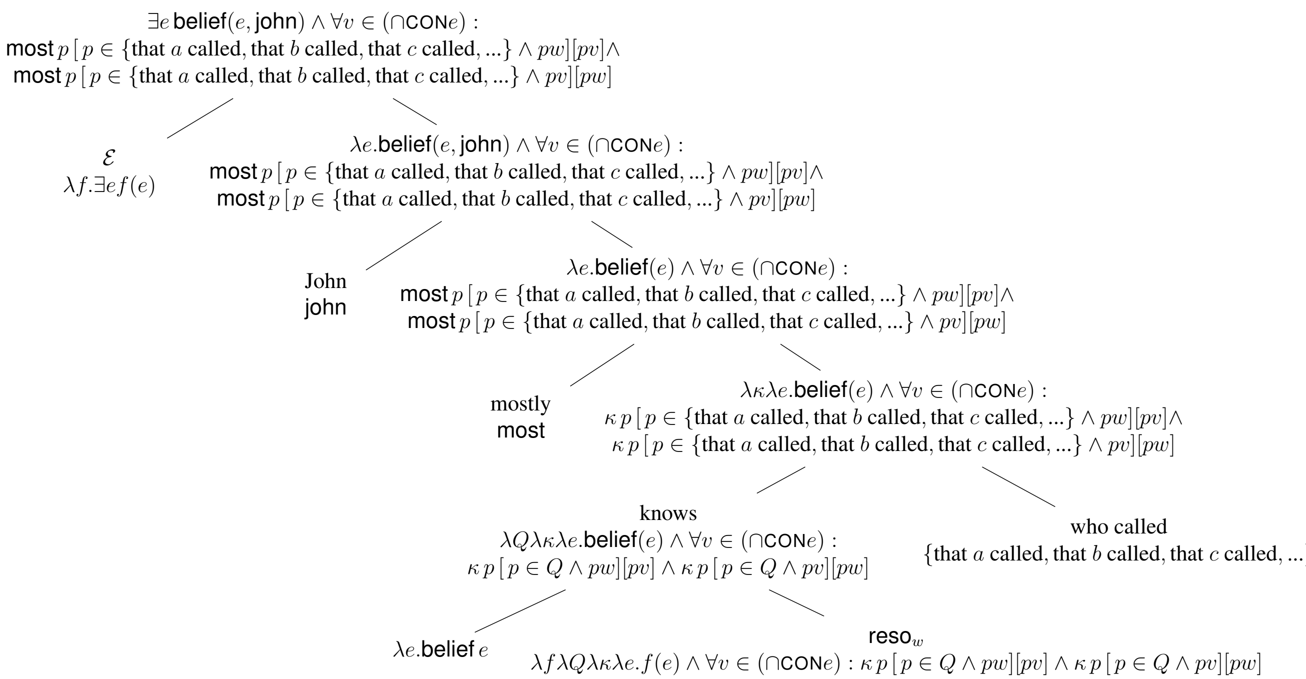
candidate callers	a	b	c	d	e	f	g	h	i	j
true world w	T	T	T	T	F	F	F	F	F	F
John's belief worlds	T	T	T	F	T	T	T	T	T	T

Scenario B

candidate callers	a	b	c	d	e	f	g	h	i	j
true world w	T	T	T	T	F	F	F	F	F	F
John's belief worlds	T	T	T	F	T	F	F	F	F	F

B Full derivation of the QV reading

The tree below gives the detailed derivation for the targeted QV reading of the example sentence *John mostly knows who called*. I abstract away from details related to tense and possible worlds in the matrix clause, as they don't concern us here. I assume a covert event closure, represented by the symbol $\mathcal{E}$.



Selected References. **Aloni, M., & Roelofsen, F**.(2011). Interpreting concealed questions. *Linguistics and Philosophy,* 34(5), 443-478. **Beck, S., & Sharvit, Y.**.(2002). Pluralities of questions. *Journal of Semantics*, 19(2), 105-157. **Berman, R.**(1991). *On the semantics and logical form of wh-clauses*. PhD dissertation, University of Massachusetts at Amherst. **Groenendijk , J. & Stokhof, M.**(1993). *Interrogatives and adverbs of quantification*, ILLC. **Hacquard, V.**(2010). On the event relativity of modal auxiliaries. *Natural language semantics*, 18(1), 79-114. **Heim, I.** (1994). Interrogative complements of *know*. *ITAL* 1. 128 - 144. **Lahiri, U.** *Questions and Answers in Embedded Contexts*. Oxford University Press.