Embedded Questions are exhaustive, alright, but...

We discuss the semantic and pragmatic nature of different exhaustivity levels in embedded questions under *know* and *surprise*. Based on novel data from German particles and Q-adverbs in interaction with such questions, we argue that their semantic interpretation is not strongly exhaustive (SE) (Groenendijk & Stokhof 1984, George 2011), but only involves weak exhaustivity (WE), as discussed in Heim (1994) and subsequent work on intermediate exhaustivity (IE) (Klinedinst & Rothschild 2011 i.a.). Stronger interpretations result from pragmatic strengthening, cf. also Uegaki (2015). We push towards a theory of embedded question meanings as underlyingly WE based on a maximality answer operator, inspired by but different from Rullmann's (1995), which interacts with the semantics of the matrix verb.

Background I: Embedded questions under distributive upward entailing *know* were originally thought to have a SE-reading only (G&S 1984). (1) is hence true iff Paula knows of all the dancers that they danced, and of all the people that didn't dance that they didn't, i.e. she knows the full list of dancers and that this list is complete (Heim 1994).

(1) Paula knows who danced.

Cremers & Chemla (2016) present experimental evidence that embedded questions under *know* also allow for a weaker (IE) reading, according to which Paula knows the full list of dancers and holds no false beliefs regarding any non-dancers. This reading is compatible with a basic WE-construal that we focus on here (see below). The cognitive-emotive and downward-entailing (Romero 2015) verb *überraschen* 'surprise' in (2) is claimed to be non-distributive (Lahiri 2002). According to this analysis, Paula's surprise can be directed at (one or more) outliers (2ii) (Guerzoni & Sharvit 2007). In addition, *surprise* has a stronger, homogeneous reading under which Paula's surprise is about each individual answer she holds to be true (2i) (Berman 1991). Both readings in (2i) and (2ii) qualify as WE readings (Paula is surprised at the full list in one way or another). The SE-reading under downward entailing *surprise* is weaker, such that (2) would already be true if Paula were surprised by a single non-dancer. Such weak SE-readings are generally not attested with *surprise*.

(2) It surprises Paula who danced.
  i. Paula is surprised by each of the dancers.
  ii. Paula expected a number of the dancers, but she didn't expect boring Paul to dance.

The core question is whether the different surface readings observable with questions under *know* and *surprise* are **semantically** distinct or not. Are embedded questions semantically ambiguous, possibly due to different semantic ANSwer-operators (eg. Heim 1994, Beck & Rullmann 1999)? Or is there but a single semantic representation with additional pragmatic readings? If so, is WE in (1) pragmatically derived from underlying SE and domain restriction (George 2011), or is SE pragmatically derived from underlying WE/IE (Uegaki 2015)?

Background II: The discourse particle *schon* 'alright' and the Q-adverb *teilweise* 'partially' interact with embedded questions in different ways. Zimmermann (2018) analyses *schon* as a not-at issue root modal operator indicating that the factual evidence in favour of *p* outweighs evidence for not-*p*. In addition, **stressed *schon* can be used to block various implicatures (3)**, but not semantic inferences: Adding *schon* does not improve (4a), in which maximality is semantically coded by DEF *diese* 'these'. The Q-adverb *teilweise* 'partially' operates on quantificational sub-event structures (Krifka 1989), marking such sub-structures as incomplete (4b). For distributed states and achievements, this typically marks the domain of distribution as incomplete, whereas with accomplishments and degree-related verbs this may lead to other types of incompleteness (4c). Finally, ***teilweise* does not block pragmatic implicatures (5):**

(3) a. Is Paul hungry? (Has he had breakfast?)

Paul hat (***SCHON***) gefrühstückt.	w/o PRT:	→ Paul is not hungry
Paul has PRT had.breakfast	***with PRT:***	↛ ***Paul is not hungry (no implicature)***

b. How many gherkins did Paul eat? (Did he eat some?)
Paul hat (***SCHON***) einige Gurken gegessen w/o PRT: → not all
Paul has PRT some gherkins eaten ***with PRT: ↛ not all***

(4) a. #Paul hat diese Gurken (***SCHON***) gegessen, *but not all*.
b. Paul hat diese Gurken #(***teilweise***) gegessen, *but not all*.
c. Paula ist teilweise glücklich. 'Paula is partially happy.'

(5) Are the children hungry? Have they had breakfast?
Die Kinder haben (teilweise) gefrühstückt. → those with breakfast are not hungry

Novel Data on particles/Q-adverbs+*know*: The interpretation of embedded questions is affected in different ways by the addition of *schon* and *teilweise*. The default SE reading of questions embedded under *know* (6) is easily blocked by adding *schon* in (7a), but *schon* cannot weaken the resulting WE-reading that Paula knows the complete list of dancers to a non-exhaustive interpretation (7b). The Q-adverb *teilweise* behaves in opposite ways: It cannot turn SE-readings into WE-readings, but it can turn WE question meanings into non-exhaustive ones. As a result, (8a) is infelicitous, as the WE-reading that Paula knows the complete list of dancers is unattested, and (8b) only has a non-exhaustive reading:

(6) Paula weiß, wer getanzt hat.
Paula knows who danced has

(7) Paula weiß ***SCHON***, wer getanzt hat,
a. *but she doesn't know that this is all*
b. # *but she doesn't know all the dancers.*

(8) Paula weiß ***teilweise***, wer getanzt hat,
a. # *but she doesn't know that this is all.*
b. *but she doesn't know all the dancers*.

Analysis: The above data do not fall out on G&S-style analyses that take the SE-reading as the only semantic interpretation of questions under *know*. In such analyses, knowledge of completeness is part of the meaning of *know+wh*, such that the Q-adverb *teilweise* should be able to operate on the excluded negative alternatives as well. (8a) should hence be felicitous in situations in which Paula knows the positive true answers, but not the negative ones or that her knowledge is complete, contrary to fact. Rather, the Q-adverb operates only on the positive answer space corresponding to the full WE-answer, resulting in non-exhaustivity (8b). Moreover, why would a semantic SE-interpretation be blocked by *schon* if the particle only targets implicatures? Ambiguity accounts run into problems a well, as there is no evidence suggesting that *schon* could be used to resolve semantic ambiguity. The fact that *schon* blocks pragmatic implicatures suggests that the WE-interpretation of (6) is basic, and that the SE-reading blocked in (7a) is pragmatic in nature.

These facts jointly require a novel account of the meaning of embedded questions. We assume that embedded questions provide the embedding verbs with their arguments in the form of plural entities, which can be semantically distributed whenever required by the verb (or syntactic structure). The analysis here simplifies and ignores compositional detail: (i.) we model the plural entity denoted by the answer operator as a mereological sum of propositions (9b) (independent evidence shows that the distribution is actually over the individuals constituting the question predicate denotation); (ii.) we also ignore factivity presuppositions of the matrix verbs although factivity is crucial for the transition from WE to IE readings, as false propositions cannot be *known*. (9c) says that *know* provides sub-events of knowing each true answer to the embedded question. The sub-events are gained by distributing over the parts of what intuitively constitutes *the answers* to the embedded question.

(9) a. $[[Who\ \ danced\ ?]] = \lambda p.\ \exists x.\ p = \lambda w.\ x\ danced\ in\ w$
b. $ans(w, Q) = \ \oplus \{p |\ p \in Q \wedge p(w)\}$
c. $know(z, Q) = \lambda w.\ \lambda e.\ R = ans(w, Q) \wedge \forall p.\ p \sqsubseteq R \rightarrow \exists e'.\ e' \sqsubseteq e \wedge K(z, p, e', w)$
d. strengthened meaning (here SE): $\exists e'' \sqsubseteq e.\ K(z,\ R = ans(w, Q),\ e'')$

Teilweise marks the sub-event structure of its argument verb as somehow incomplete. With distributed states and accomplishments, incompleteness is typically found in the domain of distribution. With *know*, this boils down to the inference that there is a true answer unknown to the subject. Crucially, the sub-event e'' in (9d) is invisible to *teilweise*, as the Q-adverb is restricted to semantic and not pragmatic content! In contrast, *schon* does not alter the truth conditions in (9c), but it can block the strengthened SE-meaning (9d).

The analysis sketched in (9) also predicts that *know*+*wh*-questions with 1st person matrix subjects only allow for the stronger, pragmatic SE-interpretation. WE/IE-construals with *know* require 3rd person matrix attitude holders as in (7a) to have insufficient knowledge regarding the answer's completeness, whereas the speaker's epistemic state contains this information. With 1st person subjects, speaker and attitude holder are the same, making a clash in information states impossible. As self-ascribed knowledge is complete, only the stronger SE-reading is available, resulting in the infelicity of self-contradictory (10):

(10) # I know who danced but I don't know that these are all the people that danced.

The analysis also makes some interesting novel predictions for *surprise*: As *surprise* is not distributive, we expect *teilweise* to have no obligatory impact on exhaustification of its sub-event structure. As a result, the presence or absence of the Q-adverb does not have a very clear effect in (11a). At the same time, pragmatic strengthening of WE with *surprise*+*wh* does not result in SE, as this reading is logically weaker under downward entailing *surprise*, but in homogeneity/completeness: the subject is surprised by each individual. We correctly predict that *schon* can block this enriched interpretation, as shown in (11b):

(11) a. Es hat Paula ***teilweise*** überrascht, wer getanzt hat. → partial surprise
b. Es hat Paula ***schon*** überrascht, wer getanzt hat, *but not each dancer surprised her*.
It has Paula PRT/Q-Adv surprised who danced has
'It surprised Paula in part who danced.' / 'In a sense, it surprised Paula who danced.'

Conclusion: We observed that pragmatic strengthening of the meaning of embedded interrogatives to SE-readings (with *know*) and homogeneous readings (with *surprise*) can be blocked by the stressed particle *schon* 'alright', whereas the Q-adverb *teilweise* 'partially' changes the semantic interpretation, turning embedded questions non-exhaustive with some verbs. Based on this, we proposed a semantic analysis of embedded questions taking the WE-reading as the only semantic interpretation of embedded interrogatives, against most current analyses. Stronger, or more specific readings may arise depending on semantic properties of the embedding matrix verbs (monotonicity, sub-event structure, distributivity, factivity...). This explains the known empirical differences between the SE-reading under *know* and a special homogeneous variant of WE with *surprise*.

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