

Another Look at Exhaustivity Effects and the ‘de dicto’ Reading in Embedded Interrogatives

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1 Introduction

Both exhaustivity effects and the so-called ‘de dicto’ reading are well-known and much discussed topics in the literature on the syntax and semantics of embedded *wh*-interrogatives. Though the discussion can be traced back to, at least, Belnap (1963), these phenomena only became really prominent with the work of Groenendijk and Stokhof (1982, 1984). Criticizing Karttunen’s (1977) adaption of Hamblin’s (1973) ‘set of propositions’ approach, Groenendijk and Stokhof (1982, 1984) argue that an adequate semantics for embedded interrogatives needs to account for the (in)validity of at least the following inferences:

- | | |
|---|--|
| (1) John knows who came to the party.
Mary came to the party. | (2) John knows who came to the party.
Sue didn’t come to the party. |
| ————— | ————— |
| John knows that Mary came to the party. | John knows that Sue didn’t come to the party. |
| (3) John knows where one can buy coffee mugs.
Starbucks sells coffee mugs. | (4) John knows who came to the party. |
| ————— | ————— |
| John knows that Starbucks sells coffee mugs. | John knows which students came to the party |

(1) and (2) are claimed to be valid. (1) illustrates the so-called *weak exhaustive* reading: For *John knows who came to the party* to be judged true, John (only) needs to know of everybody who came to the party that s/he came to the party. (2) illustrates the *strong exhaustive* reading: For *John knows who came to the party* to be judged true, John needs to know of all people who came to the party that they came (weak exhaustive knowledge), and, in addition, that nobody else came to the party (from which he can, of course, conclude that Sue didn’t come to the party). The most prominent reading of *John knows where one can buy coffee mugs* is called the *non-exhaustive* (or *mention-some* or *existential*) reading: In this reading, it is already sufficient that John knows one place or another where one can buy coffee mugs. Relative to this reading the inference in (3) is felt to be invalid. Finally, let’s have a look at (4). Intuitively, (4) is felt to be invalid, too (at least in one reading). Why is that? It seems that in case a *wh*-phrase carries an overt restriction, the knowledge attributed to the matrix subject tends to not only relate to the verbal predicate, but to extend to the *wh*-phrase’s restriction: John is asserted to know of all students who came to the party that they came *and* to know that they are students. This is called the ‘de dicto’ reading of the *wh*-phrase/-complement.

Crucial for Groenendijk and Stokhof’s argumentation is the data in (2) and (4). Firstly, in Karttunen’s (1977) approach a question like *which students came* is taken to denote the set of true propositions of the form *x came*, where *x* is a student, cf. (5b); secondly, it is assumed that to know a question *Q* is equivalent to know every element in *Q*. Thus, Karttunen’s analysis accounts for (1), but it does not account for (2); nor does it account for (4) (since the restriction *student* is not part of the condition on *p*).

- (5) a. John knows which students came.
 b. $\lambda p \exists x [\text{student}(w)(x) \wedge p(w) \wedge p = \lambda w. \text{came}(w')(x)]$
 c. $\lambda p \exists x [\text{student}(w)(x) \wedge p(w) \wedge (p = \lambda w. \text{came}(w')(x) \vee p = \lambda w. \neg \text{came}(w')(x))]$

To account for strong exhaustive readings, Karttunen (1977, 21f.) discusses (5c) as a possible alternative anal-

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ysis, but gets to the conclusion, that this analysis needs to be rejected, since it implements truth-conditions that are too strong. (Consider, e.g., the sentence *John knows which elementary particles have been discovered so far.*) Groenendijk and Stokhof, on the other hand, propose a propositional analysis in which *wh*-complements denote strong exhaustive propositions. Say, John, Bill, and Mary came to the party, then *who came to the party* essentially encodes the information that John, Bill, Mary, and nobody else came to the party. This analysis can be shown to capture the ‘de dicto’ reading in a very straightforward way, and to be extendable to also account for non-exhaustive readings (cf. Groenendijk and Stokhof, 1984, 534ff).

Weak exhaustiveness in this account is just an entailment of strong exhaustiveness. However, most notably Berman (1991) and Schwarz (1994) show that predicates like *to tell* or *to rattle off* show a strong tendency towards a weak, but not strong exhaustive reading:

- (6) a. John told Peter who came to the party.
b. John rattled off who came to the party.

Heim (1994) and others conclude from these facts that what is needed for an empirically adequate semantics for *wh*-complements is a more flexible approach to exhaustivity, the strategy being to enrich a variant of Karttunen’s semantics with different kinds of answerhood conditions. In the remainder of this paper, I will first discuss the most prominent proposal of this kind, namely the Heim/Beck/Rullmann approach, and I will show that this approach does not account for an important class of empirical data. Following this discussion, I will —basically pursuing the same strategy— develop an alternative approach within traditional possible worlds semantics.¹ This approach crucially relies on the assumption that embedded *wh*-interrogatives denote generalized quantifiers ranging over properties of true answers. In the last part of the paper, I will finally present a pragmatic analysis of the ‘de dicto’ reading that is based on the use of structured propositions.

2 Embedded Interrogatives and Exhaustivity Effects

As already hinted at in the last section, Heim (1994) showed in detail that it is in principle possible to enrich Karttunen’s semantics for embedded questions with answerhood conditions resulting in a propositional approach (more or less) in the spirit of Groenendijk and Stokhof. Intuitively speaking, in a sentence like *John knows who came to the party* the matrix predicate *know* relates the matrix subject to the (denotation of the) answer to the embedded question *Q* rather than to the (denotation of the) embedded question *Q* itself. Since answers are of a propositional nature, it is straightforward to derive an answerhood condition answer_1 implementing weak exhaustiveness by simply taking the intersection of the question’s denotation, cf. (7a). (This could be a type-shifting operation or triggered by the lexical semantics of the embedding predicate.)

- (7) a. $\llbracket \text{answer}_1(w)(Q) \rrbracket := \bigcap \llbracket Q \rrbracket(w)$ (type $\langle s, t \rangle$)
b. $\llbracket \text{answer}_2(w)(Q) \rrbracket := \lambda w' [\bigcap \llbracket Q \rrbracket(w) = \bigcap \llbracket Q \rrbracket(w')]$ (type $\langle s, t \rangle$)
c. $\llbracket \text{answer}_3(w)(Q) \rrbracket := \lambda P \exists p [P(w)(p) \wedge Q(w)(p) \wedge p(w)]$ (type $\langle \langle s, \langle \langle s, t \rangle, t \rangle \rangle, t \rangle$)

Using Groenendijk and Stokhof’s mechanism of deriving partitions by comparing denotations in each possible world, we can derive a second answerhood condition, answer_2 , on the basis of answer_1 , cf. (7b). This answerhood condition is (almost) equivalent to Groenendijk and Stokhof’s analysis of *wh*-complements and therefore licenses inferences exemplifying strong exhaustiveness. Finally, to account for non-exhaustive readings, Beck and Rullmann (1999) propose to add another answerhood condition to the analysis, answer_3 , which is essentially an existential generalized quantifier over properties of propositions, cf. (7c).

When discussing questions of exhaustiveness, the relevant literature almost exclusively focuses on *know*-type predicates which have been dubbed *extensional* in Groenendijk and Stokhof (1982). If we have, however, a somewhat closer look at the so-called *intensional* predicates of the *wonder*-type class,

- (8) a. John wonders where he can buy a coffee mug.
b. John wants a detailed list (of) who plans to attend the conference.
c. John investigates which/how many predicates embed strong exhaustive interrogatives.

¹ Being primarily concerned with extensions and/or modifications of the traditional Hamblin/Karttunen approach, I won’t enter here into a discussion of the interesting proposal presented in van Rooy (2003).

we can observe exactly the same phenomenon: predicates of this class also allow for non-exhaustive — cf. (7c)—, weak exhaustive —cf. (8b)—, and strong exhaustive —cf. (8c)— readings. Though this is not necessarily a problem,² it is a problem, if it is assumed that *wonder*-type predicates simply denote relations between individuals and questions (cf. e.g. Berman, 1991, and more carefully Beck and Rullmann, 1999).

In this paper, I want to propose that interrogative *wh*-complements —whether embedded under an extensional predicate of the *know*-class or an intensional predicate of the *wonder*-class— uniformly refer to a complete question/answer sequence: *wh*-complements denote generalized quantifiers ranging over properties of true answers, where true answers are taken to be sets of true propositions. The basic idea underlying this analysis is that *wh*-complements behave in many respects parallel to indefinites in extensional and intensional contexts. Within a Montague-style analysis, indefinites denote generalized quantifiers ranging over properties of individuals. If the indefinite is embedded under an intensional predicate (in its *de dicto* reading) like, e.g., *seek* (of type $\langle s, \langle \langle s, \langle \langle s, \langle e, t \rangle \rangle, t \rangle \rangle, \langle e, t \rangle \rangle \rangle$), the quantifier's intension serves as the semantic argument of the intensional predicate. If it is embedded under an extensional predicate like, e.g., *find* (of type $\langle s, \langle e, \langle e, t \rangle \rangle \rangle$), the quantifier leaves a trace of type *e*, and raises to a position above the extensional predicate; as a consequence the order of functor and argument is inverted.

(9) John seeks a unicorn.

- a. **seeks**(*w*)(**John**, $\lambda w' . \lambda P \exists x [\mathbf{unicorn}(w')(x) \wedge P(w')(x)]$)
- b. $\lambda P \exists x [\mathbf{unicorn}(w)(x) \wedge P(w)(x)] (\lambda w' \lambda x . \mathbf{finds}(w)(\mathbf{John}, x))$

A similar analysis is in fact available in case of *wh*-complements. Suppose the unembedded variant *Q* of the question *where he can buy a coffee mug* denotes in *w* the set of (not necessarily true) propositions of the form *he can buy a coffee mug at x*, where *x* is some place in *w*. Suppose furthermore that any subset *X* of *Q* in *w* is a possible answer to *Q* in *w* ($\llbracket \text{answer}(w)(X)(Q) \rrbracket = 1$ iff $X \subseteq Q(w)$), and that it is a true answer, if every proposition contained in *X* is true ($\llbracket \text{true}(w)(X) \rrbracket = 1$ iff $\forall p, p \in X, p(w) = 1$). Given this, the *wh*-complement in (10a), in its non-exhaustive reading, is assigned the denotation in (10b), an existential generalized quantifier over properties of true answers.

- (10) a. (John knows) where he can buy a coffee mug
 b. $\lambda w \lambda P \exists X [(\text{answer}(w)(X)(Q) \wedge \text{true}(w)(X)) \wedge P(w)(X)]$

Being an extensional question embedding predicate, *know* is of semantic type $\langle s, \langle \langle \langle s, t \rangle, t \rangle, \langle e, t \rangle \rangle \rangle$ (and of type $\langle s, \langle \langle s, t \rangle, \langle e, t \rangle \rangle \rangle$ if it embeds a declarative complement); thus, to avoid a type mismatch, the *wh*-complement needs to raise at LF, cf. (11c). Its interpretation results in exactly the intended reading, cf. (11b): John_{*i*} needs to know some answer to the question *Where can I_i buy a coffee mug?*³

- (11) a. John knows, where he can buy a coffee mug.
 b. John [1 [[where he can buy a coffee mug] [2 [t₁ knows t₂]]]]
 c. $\lambda w . \exists X [(\text{answer}(w)(X)(Q) \wedge \text{true}(w)(X)) \wedge \mathbf{know}(w)(X)(\mathbf{john})]$

In its overall shape this analysis is very similar to the analysis of non-exhaustive readings in Beck and Rullmann (1999), the only difference being that in the Beck/Rullmann approach answer₃ ranges over properties of propositions, rather than over properties of sets of propositions as proposed here. But there are two more crucial differences. Firstly, I explicitly assume *wonder*-predicates to be intensional question embedding predicates of type $\langle s, \langle \langle s, \langle \langle s, \langle \langle s, t \rangle, t \rangle \rangle, t \rangle \rangle, \langle e, t \rangle \rangle \rangle$, i.e., (12a) is interpreted as (12b).

- (12) a. John wonders where he can buy a coffee mug.
 b. **wonders**(*w*)(**john**, $\lambda w' \lambda P \exists X [(\text{answer}(w')(X)(Q) \wedge \text{true}(w')(X)) \wedge P(w')(X)]$)

² The Heim/Beck/Rullmann approach could in fact be generalized to *wonder*-type predicates along the lines suggested by the analysis in Groenendijk and Stokhof (1982). We will see, however, that the proposal presented below shows some additional interesting implications related to the analysis of quantificational variability on the one hand, and the 'de dicto' reading on the other hand.

³ Following Karttunen (1977), I assume that to know a set of propositions *X* is equivalent to know every proposition *p* that is an element of *X*. As Karttunen noted himself, there is a potential problem with the empty set: If the set in question is empty, the *know*-relation is trivialized. There are two remarks in place here. First, I've got strong intuitions that in non-exhaustive readings this situation seems to be excluded by background assumptions, i.e., by some kind of existential presupposition. This is, however, most probably not true for exhaustive readings. I will therefore assume that empty *wh*-complements are always subject to a strong exhaustive interpretation. In this case the matrix subject will know the proposition that the maximal true answer to the question is the empty set (cf. (13c) below).

Thus, whatever the correct lexical semantics of *wonder* looks like, non-exhaustive (de dicto) readings are predicted to be possible not only in case of *know*-type predicates, but also in case of *wonder*-type predicates. Secondly, the answerhood condition *answer3* in Beck and Rullmann’s approach is very different from *answer1* and *answer2*, and it seems to have some kind of independent status. In the analysis proposed here, the non-exhaustive reading is the most basic answerhood condition in the sense that it serves as the starting point to derive both the weak and the strong exhaustive reading. The weak exhaustive reading (not the strong exhaustive one as in Rullmann (1995)) is derived by adding a maximality constraint as a condition on X , cf. (13b):⁴ weak exhaustive answers are simply maximal true answers. The strong exhaustive reading, in turn, is derived on the basis of the weak exhaustive reading, and captures exactly the closure condition intuitively underlying strong exhaustivity: the property \mathcal{P} of ‘being known by John’ (λX . that John knows X) not only applies to the maximal true answer X , but extends to its description of being a maximal true answer, cf. (13c):⁵ John knows the maximal true answer, and he knows that this answer is in fact the maximal true answer. This way of defining strong exhaustiveness obviously avoids the potential problems related to incorporating strong exhaustiveness in a set-based approach as discussed in Karttunen (1977).

- (13) a. $\lambda w \lambda \mathcal{P} \exists X [(\text{answer}(w)(X)(Q) \wedge \text{true}(w)(X)) \wedge \mathcal{P}(w)(X)]$
 b. $\lambda w \lambda \mathcal{P} \exists X [\max(X, \lambda Y. \text{answer}(w)(Y)(Q) \wedge \text{true}(w)(Y)) \wedge \mathcal{P}(w)(X)]$
 c. $\lambda w \lambda \mathcal{P} \exists X [\max(X, \lambda Y. \text{answer}(w)(Y)(Q) \wedge \text{true}(w)(Y)) \wedge \mathcal{P}(w)(X)$
 $\quad \wedge \mathcal{P}(w) (\circ \lambda w'. \max(X, \lambda Y. \text{answer}(w')(Y)(Q) \wedge \text{true}(w')(Y)))]$

From what has been said by now, it should be clear that weak exhaustive and strong exhaustive (de dicto) readings are predicted to be available in case of *wonder*-type predicates as well, i.e., the data presented in (8) above can be accounted for. This is apparently not true for proposals like Berman (1991) and Lahiri (1991, 2000) that analyse answerhood conditions as special instances of a phenomenon dubbed the *quantificational variability effect*, cf. (14), which is generally assumed to be only available in case of *know*-type predicates.

- (14) John mostly knows who cheated at the exam.
 (= For most people, who cheated at the exam, John knows that they did.)

This does not mean, however, that the analysis presented above is in any way incompatible with a straightforward treatment of the quantificational variability data. On the contrary. Since raising the *wh*-complement in case of *know*-type predicates leaves a trace of type ‘set of propositions,’ and since this trace is in the c-command domain of the quantificational adverb, there should be several ways to approach the syntax and semantics of quantificational adverbs.⁶ Though I’m not yet in a position to give a fully explicit account of all the intricate problems related to these effects, I’d like to nevertheless sketch a possible analysis that gives an impression of what such an account could look like. First consider once more the proposed analysis in case of a, say, weak exhaustive reading. The *wh*-complement raises to the matrix-VP for type reasons and leaves a trace t_2 of type $\langle \langle s, t \rangle, t \rangle$. This LF is interpreted in (15c) and reduces to (15d).

- (15) a. John knows, who cheated at the exam.
 b. John [1 [[who cheated at the exam] [2 [t₁ knows t₂]]]]
 c. **John** λx [$\lambda \mathcal{P} \exists X [\max(X, \lambda Y. \text{answer}(w)(Y)(Q) \wedge \text{true}(w)(Y)) \wedge \mathcal{P}(w)(X)] (\lambda X. x \text{ knows } X)$]
 d. $\lambda w. \exists X [\max(X, \lambda Y. \text{answer}(w)(Y)(Q) \wedge \text{true}(w)(Y)) \wedge \text{know}(w)(X)(\text{john})]$

Now consider the variant (16a) of (15a) containing the quantificational adverb *mostly*. Suppose that the quantificational adverb *mostly* is coindexed with the *wh*-complement, cf. (16a), and that raising the *wh*-complement leaves a complex trace of type $\langle s, t \rangle$, cf. (16b). By assumption, the interpretation of the complex trace consists of (i) a variable X of type ‘set of propositions’ bound by the moved *wh*-complement, and (ii) a choice function variable f_i of type $\langle \langle \langle s, t \rangle, t \rangle, \langle s, t \rangle \rangle$ operating on the variable X and being bound by the

⁴ Maximality is defined in the usual manner: $\llbracket \max(X, \mathcal{P}) \rrbracket = 1$ iff (i) $\llbracket \mathcal{P}(X) \rrbracket = 1$, and (ii) $\llbracket \forall Z (\mathcal{P}(Z) \rightarrow Z \subseteq X) \rrbracket = 1$. It should be noted here that this way of defining maximality copes with all the potential problems related to the use of maximality operators as discussed in detail in Beck and Rullmann (1999). This is simply because this definition —like *answer1*— operates on a propositional level. Note also that it is important to distinguish semantics from pragmatics in case of maximal answers. If, for example, all propositions contained in the maximal true answer are linearly ordered with respect to the entailment relation (i.e., $p_1 \subseteq p_2 \subseteq \dots \subseteq p_n$), then the maximal true answer is the set $\{p_1, p_2, \dots, p_n\}$, but —following Gricean maxims— a speaker will only articulate p_n .

⁵ The operator ‘ \circ ’ shifts a proposition to the singleton set containing it.

⁶ Note that in Beck and Rullmann (1999)’s analysis the trace just refers to an (unstructured) proposition.

coindexed quantificational adverb *mostly*, cf. (16c).⁷ Given that *mostly* quantifies over minimally defined choice functions (i.e., choice functions with domain $\{g(X)\}$), this results in the representation in (16d), where $\llbracket \mathbf{most}(\lambda f_i. \mathbf{know}(w)(f_i(X))(\mathbf{john})) \rrbracket^g = 1$ if and only if for most choice functions f with domain $\{g(X)\}$ John knows the proposition $f(g(X))$. This is, of course, essentially equivalent to the proposition that for most people who did cheat at the exam, John knows that they did.

- (16) a. John *mostly_i* knows, [who cheated at the exam]_{*i*}.
 b. John [1 [[who cheated at the exam] [2 [t₁ *mostly_i* knows t_{2,*i*}]]]]
 c. **John** $\lambda x [\lambda \mathcal{P} \exists X [\max(X, \lambda Y. \text{true-ans}(w)(Y)(Q)) \wedge \mathcal{P}(w)(X)] (\lambda X. x \text{ mostly } \lambda f_i [\mathbf{knows } f_i(X)])]$
 d. $\lambda w. \exists X [\max(X, \lambda Y. \text{true-ans}(w)(Y)(Q)) \wedge \mathbf{most}(\lambda f_i. \mathbf{know}(w)(f_i(X))(\mathbf{john}))]$

This sketch of an analysis shows that there is indeed a compositional way to derive the interaction of answerhood conditions and quantificational adverbs within the proposed approach, while at the same time predicting that this effect is only available with *know*-type predicates. (The analysis presupposes (i) raising of the *wh*-complement, and (ii) that the relevant predicate also subcategorizes for declarative sentences.) Technically, it is in principle possible to generalize this analysis to non-exhaustive and strong exhaustive readings. It seems to me, however, that the readings in question are filtered out pragmatically and/or semantically: In case of non-exhaustive readings we systematically expect the possibility that X only denotes a singleton set, and in case of strong exhaustive readings the maximality condition is always contained in a singleton set. Depending on one's theory, this is incompatible with the semantics of *most* or it trivializes its semantics.

3 Embedded Interrogatives and the ‘de dicto’ Reading

In the previous section it has been shown that the proposed generalized quantifier analysis of *wh*-complements allows for a type-uniform treatment of all relevant answerhood conditions, that it correctly predicts that these answerhood conditions play a crucial role not only in the semantics of *know*-type predicates, but also in case of *wonder*-type predicates, and, finally, that it is promising with respect to the treatment of quantificational variability effects. But what about the invalidity of inferences like the one presented in (4) above? If one has a closer look at the definition of the answerhood condition in (13c), repeated here as (17), it becomes clear that the two maximality conditions together encode exactly the same information that does Heim's (1994) notion *answer₃*: X is the Karttunen denotation of the question Q evaluated at index w , and the proposition to be known consists of all worlds w' in which the Karttunen denotation of Q is identical to that in w .

$$(17) \lambda w \lambda \mathcal{P} \exists X [\max(X, \lambda Y. \text{answer}(w)(Y)(Q) \wedge \text{true}(w)(Y)) \wedge \mathcal{P}(w)(X) \\ \wedge \mathcal{P}(w)(\lambda w'. \max(X, \lambda Y. \text{answer}(w')(Y)(Q) \wedge \text{true}(w')(Y)))]$$

In Heim (1994) it is proven that *answer₃* is essentially equivalent to Groenendijk and Stokhof's analysis of *wh*-complements, and thus incorporates —apart from strong exhaustiveness— a ‘de dicto’ reading of the *wh*-phrase/-complement. It is also shown that we can nevertheless derive a ‘de re’ reading —the reading in which (4) is a licit inference—, if we employ some mechanism that allows us to prevent the *wh*-phrase's world argument to be bound within the scope of the matrix predicate. Since the condition $\text{answer}(w')(Y)(Q)$ rewrites as, e.g., $\lambda p \exists x [\mathbf{student}(w')(x) \wedge p = \lambda w''. x \mathbf{cheated at the exam in } w'']$, the strong exhaustive ‘de re’ reading can be represented within the analysis developed in the last section as stated in (18): The proposition to be known now consists of all worlds w' in which the Karttunen denotation of Q is identical to that in w , but with the possible difference that x is no student in w' .

$$(18) \lambda w \lambda \mathcal{P} \exists X [\max(X, \lambda Y. \text{answer}(w)(Y)(Q) \wedge \text{true}(w)(Y)) \wedge \mathcal{P}(w)(X) \\ \wedge \mathcal{P}(w)(\lambda w'. \max(X, \lambda Y. \text{answer}(w)(Y)(Q) \wedge \text{true}(w')(Y)))]$$

Actually, I will assume from now on that the strong exhaustive reading of *wh*-complements is always to be represented as a ‘de re’ reading. The reason for this is the following: It is not only strong exhaustive readings of *wh*-complements that allow for a ‘de dicto’ reading of the *wh*-phrase; the same phenomenon can be observed, for example, in case of non-exhaustive readings, cf. (19a), which is ambiguous between a ‘de dicto’ and a ‘de re’ reading, and (19b) which only allows for a ‘de dicto’ reading.

⁷ $\text{true-ans}(w)(Y)(Q)$ is used as a shorthand for $\text{answer}(w)(Y)(Q) \wedge \text{true}(w)(Y)$.

- (19) a. John knows which students attended the conference.
 b. I know which students attended the conference.

In case of non-exhaustive answers, however, there is of course no way to derive the ‘de dicto’ reading from strong exhaustiveness. I think —and here I follow Beck and Rullmann (1999) who argue for the same conclusion, though on the basis of different data— that this constitutes strong evidence for the assumption that strong exhaustiveness and ‘de dicto’ readings are to be treated as independent phenomena.

But what could such an analysis of the ‘de dicto’ reading look like? Beck and Rullmann (1999) propose a semantic account of this reading. The basic idea is to incorporate the *wh*-phrase’s restriction into the propositions denoted by the question, and to allow for some kind of flexible binding of its world argument. One problematic aspect of this approach is that it doesn’t exclude a ‘de re’ reading in case of 1st person matrix subjects, cf (19b) above. Of course, it is always possible to filter out the unavailable reading by some pragmatic mechanism. But if we have to invoke pragmatics anyway, why shouldn’t we take the direct route? This is what I want to propose in the following.

If we follow the arguments presented in Krifka (2001) in favour of a structured meaning approach to questions and answers, it seems straightforward to assume that independent *wh*-interrogatives denote sets of structured rather than unstructured propositions, cf. (20) (cf. also Reich, 2002, 2003, for a detailed analysis).

- (20) a. Which students cheated at the exam?
 b. $\lambda w \lambda p \exists x [\text{student}(w)(x) \wedge p = \langle x, \lambda y \lambda w'.y \text{ cheated at the exam in } w' \rangle]$

In this case, however, a *wh*-complement denotes a generalized quantifier over properties of sets of structured propositions, and we need to specify what it means to know a structured proposition. Here we can take advantage of the semantics for propositional attitudes developed in Cresswell and von Stechow (1982):

- (21) *John knows* $\langle \text{Peter}, \lambda x. \text{that } x \text{ cheated at the exam} \rangle$ is true in *w* iff (i) there is an acquaintance relation ζ s.t. John uniquely refers to the person Peter via ζ , and (ii) John self-ascribes the property of being acquainted with a person via ζ which has the property $\lambda x. \text{that } x \text{ cheated at the exam}$.

The crucial point here is that the truth-conditions of propositional attitude verbs are relativized to ‘acquaintance relations’ ζ like, e.g., names, definite descriptions, and other suitable, though not necessarily linguistically expressed cognitive relations. With respect to the ‘de dicto’ reading of *which*-complements, this relativization to acquaintance relations now opens up the possibility of a pragmatic account. The basic idea is as follows: Usage of the explicit restriction *which student* (instead of the simpler *who*) correlates with a conversational point and thus triggers an implicature. This implicature is intended to convey the information that either ‘being a student’ is part of the acquaintance relation ζ_1 holding between the speaker and the person Peter, or it is part of the acquaintance relation ζ_2 holding between the matrix subject John and Peter. In the latter case this is exactly the reading that is called ‘de dicto’ in Groenendijk and Stokhof (1982) with respect to *wh*-complements. If the matrix subject is 1st person, the speaker and the referent of the matrix subject coincide, and consequently only a ‘de dicto’ reading is available; this immediately accounts for the contrast observed in (20).

4 Summary

In this paper, I tried to make two empirical points. Firstly, answerhood conditions do not only play a central role in the syntax and semantics of *know*-type predicates, but also in the case of *wonder*-type predicates. Secondly, strong exhaustiveness and the ‘de dicto’ reading of *which*-complements are two independent phenomena. With respect to the first point, I proposed a variant of the Hamblin/Karttunen semantics for *wh*-interrogatives, in which *wh*-complements denote generalized quantifiers over properties of (maximal) true answers (construed as sets of propositions), and I sketched a possible analysis of quantificational variability effects within this generalized quantifier approach. With respect to the second point, I outlined a pragmatic account of the so-called ‘de dicto’ reading that crucially relies on the use of acquaintance relations.

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