

Chapter 1

Questions

1.1 Introduction

The present chapter concerns the interpretation of interrogative sentences. In particular, the attention will be focused on who-questions and their answers. To fix ideas I adopt as formal framework the partition theory of questions of Groenendijk and Stokhof (G&S). The choice is motivated by the technical sophistication of the G&S system which enables a perspicuous formulation of the problems I intend to discuss. Most of these problems are not peculiar to the G&S analysis though and they trouble (although sometimes in different forms) other approaches as well. This holds in particular for other partition theories of questions (e.g. Higginbotham and May (1981)), but also for proposition set theories (Hamblin (1973), Karttunen (1977)), and structured meaning approaches (e.g. von Stechow (1990), Krifka (1999)).

The structure of the chapter is as follows. In section 1.2, I briefly introduce the G&S logic of questions. In section 1.3, I discuss a number of difficulties that arise for the interpretation of who-interrogatives. I argue that these difficulties are due to the standard method of individuating objects adopted in the G&S analysis. In section 1.4, I propose a modified analysis in which different methods for the identification of objects are available. Identification methods are formalized by what I call ‘conceptual covers’. Conceptual covers represent different ways of conceiving the elements of the domain. Questions are then relativized to contextually given conceptual covers. What counts as an answer to a who-question depends on which conceptualizations of the universe of discourse are used in the specific circumstances of the utterance. In the last section, I extend the analysis to other semantic theories of questions.

1.2 Partition Theory

In the partition theory of questions of G&S, the following three principles, formulated at first by Hamblin in the late 50s (see Hamblin (1958)), are formalized:

- A To know the meaning of a question is to know what counts as an answer to that question.
- B An answer is a statement.
- C The possible answers to a question form an exhaustive set of mutually exclusive possibilities.

The meaning of a question is identified with the set of its possible answers (A), that is a set of propositions (B), which determine a partition of the logical space (C).

The formal framework I adopt is based on G&S (1984, 1997). The language under consideration is a language of first order predicate logic with the addition of a question operator ‘?’.

1.2.1. DEFINITION. [Language] Let PL be a language of predicate logic. The Query Language based on PL is defined as the smallest set QL such that:

1. If $\phi \in PL$, then $\phi \in QL$;
2. If $\phi \in PL$, \vec{x} is a sequence of n variables ($0 \leq n$), then $?\vec{x}\phi \in QL$;
3. If ϕ and $\psi \in QL$, then $\phi; \psi \in QL$.

Interrogative sentences are obtained by prefixing a question mark and a sequence of n variables to a sentence of PL . A question mark can only occur as outermost operator. We do not have compound interrogatives or quantification into questions, but by the last clause we can form sequences of questions (and assertions). We can distinguish polar questions ($n = 0$), single-constituent questions ($n = 1$), and multi-constituent questions ($n > 1$), as illustrated by the following examples:

$?\exists xPx$ ‘Did anybody call?’

$?xPx$ ‘Who called?’

$?x x = t$ ‘Who is Tintoretto?’

$?xyRxy$ ‘Who invited whom?’

In the partition theory, interrogatives receive an intensional interpretation, and hence a model for our query language will contain a set of possible worlds.

1.2.2. DEFINITION. [Models] A model M for QL is a pair $M = \langle D, W \rangle$ where

- (i) D is a non-empty set of individuals;
- (ii) W is a non-empty set of worlds w that assign to each individual constant symbol a in PL an item $w(a) \in D$ and to each n -ary relation symbol R of PL a relation $w(R) \subseteq D^n$.

A model is a pair consisting of a set of individuals (the universe of discourse) and a set of worlds. A world is identified with an interpretation function for the non-logical constants in PL . So, a model can be seen as a set of ordinary first order models sharing one and the same domain. It is normal practice in formal semantics to assume models which are large enough to represent the whole space of logical possibilities. I will call such models standard models. A *standard model* for a language QL is a model $M = \langle D, W \rangle$ such that W (the logical space of the model) contains all possible interpretations w of the non-logical constants in PL on D , except, possibly, of the individual constants (singular terms) which can be interpreted as rigid designators in M . A *rigid designator* is a term which denotes one and the same individual in all possible worlds. I will call a model *rigid* if the individual constants are treated as rigid designators. According to the definition above, a rigid model is standard, if it contains all possible interpretations for the predicate constants in the language.

A classical interpretation is assumed for the indicative part of the language. The denotation of an indicative sentence relative to a world is a truth value: $\llbracket \phi \rrbracket_{M,w,g} \in \{1, 0\}$ where w is a world and g is a value-assignment to the individual variables in PL .

Interrogatives are analyzed in terms of their possible answers. The denotation of an interrogative in a given world is the proposition which expresses the complete true answer to the question in that world. In what follows I use $\vec{\alpha}$ to denote sequences $\alpha_1, \dots, \alpha_n$, where the α_i can be variables or individuals.

1.2.3. DEFINITION. [Interrogatives]

$$\llbracket ?\vec{x}\phi \rrbracket_{M,w,g} = \{v \in W \mid \forall \vec{d} \in D^n : \llbracket \phi \rrbracket_{M,v,g[\vec{x}/\vec{d}]} = \llbracket \phi \rrbracket_{M,w,g[\vec{x}/\vec{d}]}\}$$

An interrogative $?\vec{x}\phi$ collects the worlds v in which the set of sequences of individuals satisfying ϕ is the same as in the world of evaluation w . If \vec{x} is empty, $?\vec{x}\phi$ denotes, in w , the set of the worlds v in which ϕ has the same truth value as in w . For example, a polar question $?p$ denotes in w the proposition *that* p , if p is true in w , and the proposition *that not* p otherwise. As for who-questions, suppose d_1 and d_2 are the only two individuals in the extension of P in w , then the proposition *that* d_1 and d_2 are the only P is the denotation of $?xPx$ in w , that is the set of v such that $v(P) = \{d_1, d_2\}$.

Whereas indicatives express propositions, interrogatives determine *partitions* of the logical space. I will write $\llbracket \phi \rrbracket_M$ to denote the meaning of a closed sentence¹ ϕ with respect to M . If ϕ is an indicative, $\llbracket \phi \rrbracket_M$ is the set of worlds in which ϕ is true. If ϕ is an interrogative, $\llbracket \phi \rrbracket_M$ is the set of all possible denotations of ϕ in M . While the meaning of an indicative corresponds to its truth conditions, the meaning of an interrogative is identified with the set of all its possible complete answers. Since the latter is a set of mutually exclusive propositions whose union exhausts the set of worlds, we say that questions partition the logical space. Partitions can be perspicuously visualized in diagrams.

p
$\neg p$

λw [nobody is P in w]
λw [d_1 is the only P in w]
λw [d_2 is the only P in w]
λw [d_1 & d_2 are the only P in w]
\vdots
λw [all $d \in D$ are P in w]

In the first diagram, the polar question $?p$ divides the set of worlds in two alternatives, the alternative in which p is true and the alternative in which p is false.

¹Closed sentences are formulae in which no variable occurs free.

In the second diagram, the single-constituent question $?xPx$ divides the set of worlds in as many alternatives as there are possible denotations of the predicate P within M . Intuitively, two worlds belong to the same block in the partition determined by a question if their differences are irrelevant to the issue raised by the question.

Answers

A question determines a partition of the set of worlds into a number of alternatives. Each of these alternatives corresponds to a complete answer to the question. A (partial) answer is a disjunction of at least one but not all complete answers.²

1.2.4. DEFINITION. [Answers] Let ψ and $?x\vec{x}\phi$ be closed sentences in QL .

1. ψ is a (partial) *answer* to $?x\vec{x}\phi$ in M , $\psi \triangleright_M ?x\vec{x}\phi$, iff

$$\exists X \subset \llbracket ?x\vec{x}\phi \rrbracket_M : \llbracket \psi \rrbracket_M = \cup \{ \alpha \mid \alpha \in X \} \neq \emptyset$$

2. ψ is a *complete* answer to $?x\vec{x}\phi$ in M , $\psi \triangleright_M ?x\vec{x}\phi$, iff

$$\llbracket \psi \rrbracket_M \in \llbracket ?x\vec{x}\phi \rrbracket_M$$

Whereas for (non-vacuous) polar questions the notions of a complete and a partial answer collapse, the distinction is non-trivial in the case of constituent questions, for which we can have partial answers which are not complete. For example, both (a) and (b) partially answer (1), but only (b) answers (1) completely.

(1) Who called?

- a. Bill did not call.
- b. Only Eduard called.

The notion of a partial answer defines the response space generated by a particular query and can be used to characterize the notion of relevance in discourse.³ Partial answers are replies which exclusively address the issue raised by a question. Complete answers resolve an issue exhaustively. The notion of a complete

²These definitions are proposed in G&S (1984) where a more liberal notion of answerhood is also defined, which covers propositions which *imply* rather than *are* complete or partial answers. Here, such over-informative replies do not count as answers.

³See Roberts (1996b) and Groenendijk (1999) for examples of such an enterprise. They assume notions of a partial answer though, which are slightly different from the one presented here. Roberts defines partial answers as replies which are incompatible with at least one block in the partition determined by the question (see previous footnote). Groenendijk defines answers in terms of his notion of *licensing*.

answer is usually employed for the analysis of a certain class of question embedding verbs, like *know* or *tell*.⁴ These verbs can be analyzed as relations between agents and true complete answers to questions.⁵ Roughly, a sentence like ‘*a* knows wh- ϕ ’ is true iff *a* stands in the *know*-relation to the denotation of the embedded question, i.e. iff *a* believes the true complete answer to the question.⁶ The notion of a partial answer is not useful for the analysis of embedded interrogatives, as is shown by the contrast between (2) and (3).

(2) If Al knows that Bill did not call, then Al knows who called.

(3) If Al knows that only Eduard called, then Al knows who called.

We expect only the latter to be valid in our logic.

1.3 Methods of Identification

1.3.1 Dilemma

In most analyses of interrogatives a strong link exists between constituent questions and the notion of a rigid designator. On the one hand, a constituent question like ‘Who *P*?’ asks for a specification of a set of individuals. This specification requires that these individuals are semantically identified; this means that the terms from which an answer is built up must be rigid designators. On the other hand, an identity question like ‘Who is *t*?’ asks for the identification of the denotation of *t*; this means that if *t* is rigid, asking ‘Who is *t*?’ is a vacuous move. In the G&S logic of questions, two facts make this connection entirely perspicuous. I only state them here postponing a detailed proof to the Appendix A.1.

The first fact says that in a standard model *M*, the sentence ‘*t* is (the only) *P*’ (completely) answers the question ‘Who is *P*?’ iff *t* is a rigid designator in *M*. (I write $!Pt$ for the sentence expressing the proposition that *t* is the only *P*, i.e. $!Pt = \forall y(Py \leftrightarrow y = t)$).

⁴These verbs are sometimes called extensional, in contrast to intensional question-embedding verbs (like for instance *wonder*). The former take extensions of interrogatives (that is propositions) as arguments, the latter intensions of interrogatives (that is propositional concepts).

⁵Berman (1991) argues against such an exhaustive analysis of extensional question embedding verbs. See also Ginzburg (1995).

⁶One of the advantages of the G&S analysis is that we can define the notion of a complete answer directly in terms of the denotation of the question, and therefore we have a ready account of embedded uses of questions. Proponents of other approaches have to do some extra work here. See Lahiri (1991), pp. 16-22 for an attempt of a definition of the notion of a complete answer assuming a Hamblin-Karttunen denotation for questions. Her definitions are rather complicated though, and not completely general, as she admits. See Heim (1994) and Krifka (1999) for an analysis of knowing-wh constructions in the Hamblin-Karttunen tradition and in the Structured Meaning framework respectively. Their strategy consists in attempting to match the G&S predictions by complicating the lexical semantics of the relevant embedding verbs (see section 1.5).

1.3.1. FACT. [Rigidity and Answerhood] Let M be a standard model.⁷ Then

$$Pt \triangleright_M ?xPx \Leftrightarrow t \text{ is rigid in } M$$

$$!Pt \text{ } {}_c\triangleright_M ?xPx \Leftrightarrow t \text{ is rigid in } M$$

The second fact says that if t is a rigid term, then the question ‘Who is t ?’ is trivial. An interrogative $?x\phi$ is *trivial* in M iff a tautology is a complete answer to $?x\phi$ in M , i.e., if the partition determined by the question consists of a single block comprising the whole logical space.

1.3.2. FACT. [Rigidity and Triviality]

$$t \text{ is rigid in } M \Leftrightarrow ?x t = x \text{ is trivial in } M$$

These two facts have consequences that clash with our intuitions in a dramatic way. Consider again the intuitively valid principle (3) and the standard question-answer pair in (A):

(3) If Al knows that only Eduard called, then Al knows who called.

(A) Who called? ($?xPx$)

Eduard called. (Pe)

Note that according to the facts above, Pe is predicted to partially answer $?xPx$ and (3) is predicted to be valid, only if e is a rigid designator. So we would like ‘Eduard’ to be rigid. However, if we analyze proper names as rigid designators, then intuitively acceptable identity questions like (4) are rendered vacuous:

(4) Who is Eduard? ($?x x = e$)

We are faced with a dilemma: either we have to give up accounting for the ‘non-triviality’ of (4) or for the correctness of (A) and the validity of (3).

Semantic theories of questions (e.g. Hamblin (1973), Karttunen (1977), Groenendijk and Stokhof (1984)) neglect the first horn of the dilemma. These theories adopt Kripke’s influential analysis, according to which proper names are rigid designators.⁸ Interrogative sentences are interpreted with respect to standard models

⁷Recall that a standard model is a model containing all possible interpretations under which singular terms are possibly interpreted as rigid designators.

⁸See Kripke (1972), p. 48, Blackwell edition, 1980.

‘[...] although someone other than the U.S. President in 1970 might have been the U.S. President in 1970 (e.g., Humphrey might have), no one other than Nixon might have been Nixon.’

in which names are formalized as constant functions, and as a consequence of this, the acceptability of questions like (4) is not accounted for.

A more information-oriented theory of questions⁹ might choose for the second horn. Such a theory would take the strong epistemic connotation of notions like (vacuous) questions and proper answers seriously. Correct (non-vacuous) questions signal gaps in the information of the questioner, and whether a proposition provides an adequate answer depends not only on the content of the proposition, but also on the information state of the questioner. More in particular, questions like (4) are correct because subjects can lack information about the actual denotation of proper names, even though the latter are semantically rigid designators.¹⁰ In order to formalize these intuitions, questions and answers can be interpreted with respect to information states S , which are characterized as subsets of the logical space W in some standard model in which proper names can denote different individuals in different worlds. The non-triviality of questions like (4) can then be captured. In some states (4) is vacuous, in others it partitions the relevant set of worlds in a non-trivial way. On the other hand, it then depends on the relevant information state whether (3) is true, and whether (A) counts as a question-answer pair. This is the case only with respect to states in which e is identified. It should be clear that pursuing this line really means neglecting the second horn of the dilemma, and so giving up the standard account of the correctness of (A) and the validity of (3). The described information-oriented theory fails indeed to define a natural notion capable of discerning standard examples like (A) from strongly marked question-answer pairs like the following:

- (B) Is it raining?
I am going to the cinema.

First of all, note that the described information-dependent notion of an answer is not suitable for characterizing standard answers at all. As it stands, it does not even allow you to distinguish the following exemplary pair from (B) above:

- (C) Is it raining?
Yes, it is raining.

⁹G&S (1984) already recognized the connection between questions and information (cf. their notion of a pragmatic answer). Jäger (1995), Hulstijn (1997), Groenendijk (1998), Groenendijk (1999) are more recent examples of information-oriented theories of questions. As far as I know though, nobody has explicitly proposed the strategy I describe in what follows.

¹⁰It is important to notice that the phenomena which are typically considered in discussions of rigid designators (alethic modalities and counterfactuals) are of a different nature than the epistemic phenomena considered by information-oriented theories. Many authors (e.g. Hintikka (1975), Bonomi (1983), Groenendijk et al. (1996)) have distinguished semantically rigid designators from epistemically rigid designators – the former refer to specific individuals in counterfactual situations, the latter identify objects across possibilities in information states –, and concluded that proper names are rigid only in the first sense.

By properly selecting a class of worlds S , any proposition can count as an answer to any question with respect to S . For example, ‘I am going to the cinema’ counts as an answer to ‘Is it raining?’ in any S in which it is presupposed that I go to the cinema if and only if it rains. If we want to distinguish standard from marked answers ((C) from (B)), we have to abstract from the particular factual information that can be presupposed in a specific situation, and we must look at the general case. A natural way of doing this involves universal quantification over all possible states. A standard answer is a reply which is an answer with respect to any information state in which the sentence is informative. Note, however, that if proper names may have a non-rigid interpretation, the result of such universal quantification is that no answer to a who-question involving proper names will count as standard. So, no line is drawn between the intuitively correct pair (A) and the strongly marked pair (B): while pair (C) counts as standard, only an information-dependent notion of answerhood holds for both (A) and (B).

To summarize, a dilemma arises for the interpretation of constituent questions and their answers. Either we are unable to account for the correctness of questions asking for the denotation of a term t , or we do not manage to distinguish answers built up from terms t from highly marked situation-dependent answers. Standard semantic theories of questions fail to account for identity questions involving proper names. An information-oriented theory fails to account for standard answers involving proper names. Although it is correct in taking the connection between questions and information seriously and in recognizing the context dependence of the notion of an answer, its treatment of who-question and their answers is inadequate. These constructions are certainly context sensitive, but as the examples in the following section will show, their sensitivity is of a different nature than is captured by an information-dependent notion of an answer.

1.3.2 Context Sensitivity

What counts as a good answer to a question in a given context depends on various pragmatic factors.¹¹ In this section, I discuss two examples illustrating one specific aspect of this context sensitivity.

Priscilla: Consider the following situation. Your daughter Priscilla is doing her homework. She asks you:

(5) Who is the president of Mali?

In order to give her an adequate answer, you fly to Mali, kidnap Konare (the actual president of Mali), bring him in your living room, and finally utter:

¹¹Many researchers have recognized the context-sensitivity of questions and answers: see Boër and Lycan (1985), Ginzburg (1995) and Gerbrandy (2000). In the latter an approach is presented which is close in spirit to mine.

- a. He [pointing at him] is the president of Mali.

Unfortunately, by uttering a proposition with, to quote Kaplan, Konare himself ‘trapped in it’,¹² you have not answered Priscilla’s intended question. You better should have said:¹³

- b. Konare is the president of Mali.

If there is such a thing as a rigid designator in natural language, the demonstrative pronoun in (a) is it. Still, in the described situation, (a) is not an appropriate answer. Literally providing the actual denotation of the relevant predicate, displaying it concretely, does not always give the required result. The notion of a rigid designator, as it is normally intended, does not seem to cut any ice in relation to these phenomena.

Compare the situation above (call it α) with the following scenario β . You are at a party with many African leaders. Priscilla wants to meet the president of Mali.

- (5) Who is the president of Mali?

- a. He [pointing at him] is the president of Mali.
b. Konare is the president of Mali.

Assume again that Priscilla does not know what Konare looks like. In context β , (a) is an adequate answer to Priscilla’s intended question, and (b) is not. What counts as an answer to a who-question depends on the circumstances of the utterance. In one situation, an appropriate answer consists in giving the name of the man; in another, it consists in pointing out the man himself. Both (a) and (b) can be thought of as providing a characterization of the actual denotation of the relevant predicate. The individual that satisfies the property ‘being the president of Mali’, namely Konare, is identified in both, only in two different ways: in (a) he is identified by ostension, in (b) by the use of a proper name. Which of (a) and (b) counts as an appropriate answer to (5) depends on which of the two methods of identification is salient in the specific circumstances of the utterance. Since Priscilla, given her purposes, is interested in locating Konare in her perceptual field in context β , an appropriate answer consists in pointing out the man himself. In contrast, given Priscilla’s goals in α , identification by proper names is the intended method of identification there. What counts as an answer to who-questions seems to depend on a contextually assumed method of identification.

The following example, which involves knowing-who constructions, illustrates the same point.

¹²See Kaplan (1978), p. 226.

¹³The contrast between (a) and (b) corresponds to the distinction between *real* and *nominal* answers (cf. Belnap and Steel (1976)) or *ostensive* and *descriptive* answer (cf. Hintikka (1976), chapter 3). The analysis I propose here will cover more than just this two-fold distinction.

Spiderman Someone killed Spiderman.

γ : You are at the police department. You have just discovered that John Smith is the culprit. You say:

c. (John Smith did it. So) I know who killed Spiderman.

δ : You now want to arrest John Smith. He is attending a (masked) ball. You go there, but you don't know what he looks like. You say:

d. (This person might be the culprit. That person might be the culprit. So) I don't know who killed Spiderman.

In both contexts, your belief state supports the following information:

(6) John Smith killed Spiderman.

However, only in context γ , (6) intuitively resolves the question:

(7) Who killed Spiderman?

So only in context γ , you can truly utter (c). Again, we find that the G&S logic has difficulties in accounting for these examples. If it is combined with the theory of rigid reference, according to which proper names and demonstratives are rigid designators, it trivially fails. If it is combined with an information-oriented notion of non-rigid reference, it is also inadequate. Intuitively in both examples, the shift from one context to the other does not involve any gain or loss of *information*. In both contexts α and β , Priscilla lacks information about the denotation of 'Konare' and in both γ and δ you don't know what John Smith looks like. Again the difficulty described in this section is not peculiar to the G&S analysis, their system only enables us to give it a perspicuous formulation.

1.3.3 The Flexible Model Strategy

In order to get a handle on the issue, I call *identifiers* in a particular situation the terms that 'belong' to the specific method of identification assumed by the questioner in that situation. For example, in β and δ above demonstratives are identifiers; in α and γ proper names are identifiers. As is evident from the examples in the previous section, natural language terms are identifiers only relative to a particular situation.

One conservative way of modeling this variability consists in formalizing identifiers in the same way as rigid designators, that is, as terms that denote one and the same individual in all elements of a certain model. Their context sensitivity is accounted for by selecting different *models* in different contexts. Paraphrasing

the notion of a Flexible Universe strategy discussed in Westerståhl (1984), I call this strategy the Flexible Model (FM) strategy.

Westerståhl (1984) discusses the context sensitivity of determiners in natural language. If talking about your party last night, I say the following sentence:

- (8) Everybody was crazy.

I don't mean to attribute madness to everybody on earth, but I clearly refer only to the people at the party. Westerståhl calls these contextually selected domains of quantification *context sets* and argues against the Flexible Universe strategy, which identifies them with temporarily chosen model universes. Although the context dependency I am discussing is somehow different from the one considered by Westerståhl, I will follow the line of his argumentation and I will argue against the Flexible Model strategy which formalizes identifiers as terms denoting constant functions in temporarily chosen (standard) models. Let us consider first how the FM strategy could account for the Priscilla case. In context β (at the party), we can interpret our sentences with respect to a (standard) model M_1 in which demonstratives denote one and the same individual everywhere, while names are analyzed as non-rigid designators. In context α (in your living room), we can adopt a (standard) model M_2 in which proper names denote one and the same individual everywhere, while demonstrative need not. We obtain that (a) counts as an answer to (5) with respect to M_1 , and (b) with respect to M_2 .

- (5) Who is the president of Mali?
- a. He [pointing at him] is the president of Mali.
 - b. Konare is the president of Mali.

Furthermore, the identity questions 'Who is Konare?' and 'Who is he?' can count as non-trivial in M_1 and M_2 , respectively. The dilemma seems to disappear: it depends on the model whether the question $?x x = t$ is vacuous, or whether the sentence Pt answers the question $?xPx$.¹⁴ By interpreting different types of terms as rigid in different situations, the FM strategy accounts for the variability shown by the examples above within the standard analysis. The right class of identifiers is clearly selected by mechanisms that belong to pragmatics rather than semantics. The FM strategy formally characterizes this selection as the selection of a suitable model. Semantic theory, it is assumed, should simply abstract from these mechanisms.¹⁵ Semantics deals with interpretation conditions, rather than actual

¹⁴Since we are dealing with temporarily selected *standard* models the difficulty arising for the information-oriented theory is avoided here. Question-answer pairs like (A) or (5) which depend on the assumed method of identification are clearly distinguished from information-dependent pairs like (B) above.

¹⁵The following quote from Higginbotham (1991), taken from Lahiri (1991), is illustrative of this strategy:

interpretations. It tells you, given a certain model, what is the interpretation of a sentence in that model. Pragmatics determines which model should be assumed in a particular situation in order to obtain the intended interpretation in that situation. By assuming such division of labor between semantics and pragmatics, the FM strategy seems to be able to account for the Priscilla example. Nevertheless, in what follows I will show that such strategy has serious methodological and empirical limitations. Different sets of identifiers should be distinguished also in the semantics if we wish to properly account for the linguistic facts. In order to see this, consider the following situation.

the workshop 1 You are attending a workshop. In front of you you have the list of names of all participants, around you are sitting the participants in flesh and blood. Consider the following dialogue:¹⁶

(9) A: Who is that man?

B: That man is Ken Parker.

A: Who is Nathan Never?

B: Nathan Never is the one over there.

In this dialogue, we seem to find a shift of identification method. In order to account for it an advocate of the FM strategy would have to adopt two different models depending on which question-answer pair she is willing to interpret. The first pair must be analyzed with respect to a structure in which proper names (and not demonstratives) are interpreted as identifiers. For the second pair we need a model in which demonstratives (and not names) are treated as identifiers. This seems to be methodologically suspect and leads to serious difficulties once we assume a perspective which takes discourses as objects of investigation rather than isolated sentences. Intuitively, (9) is a coherent piece of discourse because no move is a trivial move and each move is consistent with the rest.¹⁷ However, if we assume the FM strategy, the two questions in their non-trivial interpretation do not have any model in common. So we lack a semantic characterization of their compatibility.

‘The semantics of questions, as I have presented above, abstracts completely from the ways in which objects, or the things in ranges of higher types that are values of the interrogative variables, are given to us, or may be given to questioner or respondent. It furthermore abstracts from the questioner’s motives, if any, and other pragmatic matters. It seems to me that semantic theory, and especially the theory of truth for sentences with interrogative complements, requires this abstraction.’

¹⁶See Hintikka (1976), p. 56, where a similar example is discussed.

¹⁷See Groenendijk (1999) for an elegant formalization of such a notion of discourse coherence.

The FM strategy does not only fail on the discourse level, though. The pluralism of identification methods that it allows, is not enough to account for all cases, even on the sentential level, as shown by the next example.

the workshop 2 In the situation above you can ask (10) or assert (11):

(10) Who is who? ($?xy\ x = y$)

(11) I don't know who is who.

A typical answer to (10) is one which specifies a mapping from the set of names to the set of people in the room. In the G&S logic, even if combined with the FM strategy, (10) is trivial and so (11) is contradictory. In order to account for these sentences, we have to improve upon the G&S analysis in which different identification methods cannot play a role simultaneously.

It is interesting to notice that examples involving indexical expressions or demonstratives show the same variability that we find in the workshop cases:

(12) You come with me; you stay here.

(13) Pleased to meet you; pleased to meet you.

There are interpretations of (12) and (13) in which the speaker is not contradicting or repeating herself, because the pronoun 'you' can clearly refer to two different people, even inside a single sentence. After the influential work of Kaplan, the standard way of accounting for indexical expressions involves the introduction of the context as an explicit parameter of the interpretation function. In order to account for cases like (12) or (13), we further have to assume that the contextual parameter, which represents circumstances in continuous change, can assign different values to different occurrences of indexical or demonstrative expressions. In the following section, I adopt the same strategy to account for the variability of the interpretation of who-questions. Different sets of identifiers will be allowed to be selected in different contexts as domain of quantification for different occurrences of wh-expressions.¹⁸ The role of pragmatics in these cases is that of choosing not suitable models, as assumed by the FM strategy, but proper domains of quantification.

¹⁸See Westerståhl (1984), who proposes to account for the context-sensitivity of determiners by allowing different subsets of the universe to be selected in different contexts as domain of quantification for different occurrences of quantifiers.

Digression A number of researchers (notably Boër and Lycan) have assumed that identity questions can involve predicative uses of the copula rather than equative ones. A question like (10) would then be represented as (a) $?xP\ be(x)(P)$ rather than as (b) $?xy\ x = y$, and would not be trivial under such a representation. Note, however, that such a move would not improve the situation for the simple partition theory. The interpretation of an interrogative like (a) would involve universal quantification over a set of properties, which obviously must be contextually restricted, and, therefore, our semantics would still need to be able to distinguish different sets of properties as possible quantificational domains for different occurrences of the *wh*-phrase in order to account, for instance, for dialogues like (9). Furthermore, it is not at all clear whether the examples I am discussing here really involve predicational uses of the copula. See Higgins (1973), chapter 5, on this issue. On Higgins' taxonomy of copular sentences, the workshop examples would be classified as identificational rather than predicational, since proper names, demonstratives and *who*, cannot be used predicationally, as shown by the contrast between the first and the last three sentences in the following example:

- (14) a. John became fat.
 b. John became the president.
 c. What did John become?
 d. *John became that guy.
 e. *John became Bill.
 f. *Who did John become?

Higgins (p. 166) further observes: 'Identity sentences [expressed by means of =] are close to identificational sentences, and perhaps if one abstracts from "conditions of use" may be analyzed as identical to them'. The analysis I propose in the following section, maintains the simple representation of identity or identificational questions in terms of logical identity and accounts for their meanings by proposing a non-standard interpretation of identity statements in intensional contexts.

1.4 Questions under Conceptual Covers

In this section, I present a refinement of the G&S semantics in which different ways of identifying objects are represented and made available within one single model. Identification methods are formalized by conceptual covers. Conceptual covers are sets of individual concepts which represent different ways of perceiving

one and the same domain. Questions are relativized to conceptual covers. What counts as an answer to a who-question depends on which conceptualizations of the universe of discourse are assumed in the specific circumstances of the utterance.

1.4.1 Conceptual Covers

Conceptual covers are sets of individual concepts satisfying a number of natural constraints. Given a set of worlds W and a set of individuals D , an *individual concept* is any total function from W to D . Concepts represent ways of identifying objects. Examples of concepts are the following:

- (a) $\lambda w d$ (where $d \in D$);
- (b) $\lambda w [\text{Konare}]_w$;
- (c) $\lambda w [\text{the president of Mali}]_w$.

The concept in (a) is a constant function that assigns to all worlds the same value d . The concepts in (b) and (c) assign to each world the individual which is Konare or the president of Mali in that world respectively. I will call the value $c(w)$ that a concept c assigns to a world w , the *instantiation* of c in w .

A conceptual cover is a set of concepts which satisfies the following condition: in each world, each individual constitutes the instantiation of one and only one concept.

Given a set of possible worlds W and a universe of individuals D , a *conceptual cover* CC based on (W, D) is a set of functions $W \rightarrow D$ such that:

$$\forall w \in W : \forall d \in D : \exists! c \in CC : c(w) = d$$

The existential condition says that in a cover, each individual is identified by means of at least one concept in each world. The uniqueness condition says that in no world an individual is counted twice. In a conceptual cover, each individual in the universe of discourse is identified in a determinate way, and different conceptual covers constitute different ways of conceiving of one and the same domain.

Illustration Consider the following situation. In front of you lie two cards. One is the Ace of Spades, the other is the Ace of Hearts. Their faces are turned over. You don't know which is which. In order to formalize this situation, we just need to distinguish two possibilities. The following diagram visualizes such a simple model $\langle D, W \rangle$:

$$\begin{array}{rcl} w_1 & \mapsto & \heartsuit \spadesuit \\ w_2 & \mapsto & \spadesuit \heartsuit \end{array}$$

D consists of two individuals \heartsuit and \spadesuit . W consists of two worlds w_1 and w_2 . As illustrated in the diagram, either \heartsuit is the card on the left (w_1); or \heartsuit is the card on the right (in w_2).

There are only two possible conceptual covers definable over such a model, namely the set A which identifies the cards by their position on the table and the set B which identifies the cards by their suit:

$$A = \{\lambda w[\text{left}]_w, \lambda w[\text{right}]_w\}$$

$$B = \{\lambda w[\text{Spades}]_w, \lambda w[\text{Hearts}]_w\}$$

C below is an example of a set of concepts which is not a cover:

$$C = \{\lambda w[\text{left}]_w, \lambda w[\text{Hearts}]_w\}$$

Formally, C is not a cover because it violates both the existential condition (no concept identifies \spadesuit in w_1) and the uniqueness condition (\heartsuit is counted twice in w_1). Intuitively, C is ruled out because it does not provide a proper perspective over the universe of individuals. That C is inadequate is not due to properties of its individual elements, but to their combination. Although the two concepts *the card on the left* and *the Ace of Hearts* can both be salient, they cannot be regarded as standing for the two cards in D . If taken together, the two concepts do not constitute an adequate way of looking at the domain.

1.4.2 Interrogatives Under Cover

I propose to relativize questions to conceptual covers. Contextually supplied conceptualizations determine what counts as possible answers to constituent questions.

I add a special index $n \in N$ to the variables in QL . These indices range over conceptual covers. A model for this richer language QL_{CC} is a triple $\langle D, W, C \rangle$ where W and D are as above and C is a set of conceptual covers based on (W, D) . I introduce the notion of a conceptual perspective.

1.4.1. DEFINITION. [Conceptual Perspectives] Let $M = \langle D, W, C \rangle$ be a model for QL_{CC} , and N be the set of indices in QL_{CC} . A *conceptual perspective* \wp in M is a function from N to C .

Conceptual perspectives represent the pragmatic contexts, in that they determine the various identification methods which are used.¹⁹ In order to simplify the notation, I will ignore indices and write $\wp(x)$ for the conceptual cover assigned by \wp to the index of x . Sentences are interpreted with respect to perspectives

¹⁹The present formalization in terms of conceptual perspectives avoids the issue of how covers are contextually determined. See chapter 4 for a discussion of constraints on the selection of conceptual covers.

\wp . Only the interpretation of constituent questions which involves quantification over elements of \wp -selected conceptualizations is affected by this relativization. In case of multi-constituent questions, different variables can be assigned different conceptualizations. (Recall that $\vec{\alpha}$ stands for the sequence $\alpha_1, \dots, \alpha_n$. By $\vec{c}(w)$ I mean the sequence $c_1(w), \dots, c_n(w)$.)

1.4.2. DEFINITION. [Interrogatives under Cover]

$$[?\vec{x}\phi]_{w,g}^{\wp} = \{v \mid \forall \vec{c} \in \prod_{i \in n} (\wp(x_i)) : [\phi]_{w,g[\vec{x}/\vec{c}(w)]} = [\phi]_{v,g[\vec{x}/\vec{c}(v)]}\}$$

The idea formalized by this definition is that by interpreting an interrogative one quantifies over tuples of elements of possibly distinct conceptual covers rather than directly over (tuples of) individuals in D . If analyzed in this way, a single-constituent question like $?xPx$ groups together the worlds in which the denotation of P is identified by means of the same set of elements of the selected conceptual cover, and a multi-constituent question like $?xyRxy$ groups together those worlds in which the pairs (d_1, d_2) in the denotation of R are identified by means of the same pairs of concepts (c_1, c_2) , where c_1 and c_2 can be elements of two different conceptualizations. The following diagram visualizes the partition determined by $?xPx$ under a perspective \wp such that $\wp(x) = \{c_1, c_2, \dots\}$.

λw [no $c_i(w)$ is P in w]
λw [$c_1(w)$ is the only P in w]
λw [$c_2(w)$ is the only P in w]
λw [$c_1(w)$ & $c_2(w)$ are the only P in w]
\vdots
λw [all $c_i(w)$ are P in w]

Due to the definition of conceptual covers, in the first block of this partition no individual in D is P ; in the fourth block exactly two individuals in D are P ; and in the last block all individuals in D are P .²⁰

Illustration Consider a slightly modified version of the card situation described above. In front of you lie two closed cards. One is the Ace of Hearts, the other is the Ace of Spades. You don't know which is which. Furthermore, one of the cards is marked, but you don't know which one. We can model this situation as follows (the dot indicates that the card is marked):

w_1	\mapsto	♥	♠•
w_2	\mapsto	♠	♥•
w_3	\mapsto	♥•	♠
w_4	\mapsto	♠•	♥

Our model now contains four worlds, representing the possibilities which are compatible with the described situation. Now consider two possible conceptual perspectives: \wp and \wp' . The former assigns to the index of the variable x the cover that identifies the cards by means of their position on the table, $\wp'(x)$ identifies the cards by their suits:

$$\wp(x) = \{\lambda w[left]_w, \lambda w[right]_w\};$$

$$\wp'(x) = \{\lambda w[Spades]_w, \lambda w[Hearts]_w\}.$$

Consider the following interrogative sentence:

(15) Which card is marked? ($?x x^\bullet$)

Example (15) structures the set of worlds in two different ways depending on which perspective is assumed:

under \wp :	w_1	under \wp' :	w_1
	w_2		w_4
	w_3		w_2
	w_4		w_3

Under \wp , (15) disconnects those worlds in which the marked card occupies a different position. Under \wp' , it groups together those possibilities in which the marked card is of the same suit. In other words, in the first case, the relevant distinction is whether the left card or the right card is marked; in the second case the question expressed is whether Spades is marked, or Hearts. Since different

²⁰See also fact 1.4.3.

partitions are determined under different perspectives, we can account for the fact that different answers are required in different contexts. For instance, (16) counts as an answer to (15) only under \wp' :

(16) The Ace of Spades is marked.

The relevance of this difference is easy to see. Imagine you are playing the following game: you can take a card from the table. If it is the marked card you win one million dollars. In this scenario, given your goals (formalized by perspective \wp), (16) does not answer (15).

Consider now the following sentence:

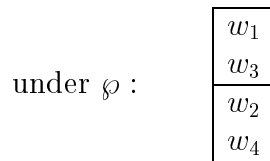
(17) Which card is which card? ($?xy \ x = y$)

Since different variables can range over different covers, we can easily account for examples like (17). Assume \wp assigns different covers to (the indices of) x and y , for instance:

$$\wp(x) = \{\lambda w[\textit{left}]_w, \lambda w[\textit{right}]_w\};$$

$$\wp(y) = \{\lambda w[\textit{Spades}]_w, \lambda w[\textit{Hearts}]_w\}.$$

If interpreted under such perspective, (17) groups together those worlds that supply the same mapping from one cover to the other, and is not vacuous in our model. The determined partition is depicted in the following diagram:



The question divides the set of worlds in two blocks: $\{w_1, w_3\}$ and $\{w_2, w_4\}$. The first alternative corresponds to the possible answer (18), the second to the possible answer (19):

(18) The Ace of Hearts is the card on the left and the Ace of Spades is the card on the right.

(19) The Ace of Hearts is the card on the right and the Ace of Spades is the card on the left.

1.4.3 Cardinality

In this section, I show that a natural property of the G&S semantics holds here as well. If two worlds w_1 and w_2 belong to the same block in the partition determined by a who-question, then the same number of (sequences of) individuals satisfy the queried property in w_1 and w_2 . The proof of this fact relies essentially on the uniqueness and existence conditions that define conceptual covers. This is a desirable fact which therefore constitutes the main justification for the two conditions.

First of all note that, intuitively, how many-questions and ‘numeral answers’ seem to be insensitive to methods of identification.²¹ Consider again the workshop situation described above, in which two identification methods were equally salient, identification by name and identification by ostension.

(20) How many persons were late today?

This question should determine one and the same partition no matter what perspective is assumed. Example (20) should be analyzed as grouping together those worlds in which the same number of people were late today, regardless of how these are identified.

Secondly, we have strong the intuition that knowing who is P implies knowing how many are P . The following is inconsistent:

(21) I don’t know how many people were late today, but I know who was late today.

In our logic these intuitions are satisfied, as can be seen from the following fact:

1.4.3. FACT. [Cardinality] Let M be a model, \wp be a conceptual perspective, g an assignment function and $\alpha \in \llbracket ?\vec{x}\phi \rrbracket_M^\wp$ be a block in the partition determined by $?\vec{x}\phi$ in M under \wp . Then

$$\forall w, w' \in \alpha : |\lambda \vec{d} \llbracket \phi \rrbracket_{M, w, g[\vec{x}/\vec{d}]}^\wp| = |\lambda \vec{d} \llbracket \phi \rrbracket_{M, w', g[\vec{x}/\vec{d}]}^\wp|$$

²¹It may be useful to notice that although how many-questions are independent of the used *epistemic* identification method formalized by the notion of a conceptual cover, they obviously depend on the presupposed *ontological* method of individuation. Conceptual covers are alternative ways of conceiving one and the same domain and so presuppose an individuation criteria for the individuals in this domain. On the issue of ontological identity and individuation see among others Gupta (1980) and van Leeuwen (1991). Gupta (1980) proposes a formalization of a relativistic view on ontological identity according to which individuation criteria are provided by the meanings of common nouns. Interestingly, he formalizes individuation criteria by means of sets of individual concepts satisfying what he calls the condition of separation, which corresponds to my uniqueness condition on conceptual covers.

Who-questions cannot group two worlds w and w' together, if the sets of (sequences of) individuals which satisfy the queried property in w and w' have different cardinality. If you know the true complete answer to the question ‘Who P ?’, then, fact 1.4.3 says that all worlds in your belief state are worlds in which the predicate P is assigned denotations of equal cardinality. If we assume that how many-questions collect those worlds in which the same number of (sequences of) individuals satisfy the relevant property, we can then conclude that if you believe the true complete answer to the question ‘Who P ?’, then you believe the true complete answer to the question ‘How many P ?’. In the present logic, you know how many P , if you know who P .

The proof of fact 1.4.3 follows directly from the existential and uniqueness conditions on conceptual covers. Irrespective of which perspective you assume, the number of the sequences of individuals satisfying a certain property doesn’t change.²² If we had allowed questions to quantify over randomly collected concepts, rather than conceptual covers, fact 1.4.3 would have been falsified. As an illustration, consider the model visualized in the following picture:

$$\begin{array}{lcl} w_1 & \mapsto & \heartsuit^\bullet \spadesuit \\ w_2 & \mapsto & \spadesuit^\bullet \heartsuit \end{array}$$

Consider again the set of concepts $C = \{\lambda w[\text{left}]_w, \lambda w[\text{Hearts}]_w\}$, which as we saw, is not a conceptual cover. Consider now the following interrogative sentence:









(15) Which card is marked?

Suppose we interpret (15) as grouping together those worlds in our model in which the marked card is the instantiation of the same elements of C . Then (15) would place the two worlds w_1 and w_2 in the same block, thus supplying a counterexample to our cardinality fact. Assume the two worlds constitute your information state. In such a situation, it would be predicted that you know which card is marked without knowing how many cards are marked, which is highly counter-intuitive.

A weaker condition than the one proposed for conceptual covers would be sufficient to prove the cardinality fact 1.4.3. Indeed, it would be enough to relativize questions to sets of concepts satisfying the following requirement: in each world all individuals are the instantiations of the same number of concepts. That is, we could relativize questions to unions of conceptual covers, rather than single ones. I don’t have knock-down arguments against this proposal. However, its predictions do not seem to fully match our intuitions. For example, consider again the card situation described in the previous section, depicted by the following

²²See also the related proposition 4.1.2, in chapter 4.

diagram:

w_1	\mapsto		
w_2	\mapsto		
w_3	\mapsto		
w_4	\mapsto		

Consider now the following question:

(22) Which card is marked? ($?x x^\bullet$)

Such an analysis would predict that in this situation a question like (22) can have a reading in which it is resolved only after the question ‘Which suit is in which position?’ has been resolved. Indeed, (22) can be interpreted under the union of the two covers $\{\lambda w[\textit{left}]_w, \lambda w[\textit{right}]_w\}$ and $\{\lambda w[\textit{Spades}]_w, \lambda w[\textit{Hearts}]_w\}$. On my account, questions like (15) cannot have such a counter-intuitive meaning. If you want to know which card is marked and which suit is in which position, you should express it by asking not one, but two questions. A further counter-intuitive prediction of a theory which allows wh-expressions to range over arbitrary unions of covers is that any constituent question can have readings in which it is resolved only after every other possible issue is resolved. If the domain of quantification is taken to be the union of all conceptual covers (that is the set of all concepts), the partition obtained is indeed extremely fine-grained: each block contains only a single world. On my account, instead, wh-questioners cannot be that demanding. If you want to shift from a state of minimal information to a state of maximal information, you cannot do it by asking a single arbitrary constituent question.

1.4.4 Answers under Cover

We can relativize the notions of a partial and a complete answer to conceptual perspectives in an obvious way. I write $\llbracket \phi \rrbracket_M^\wp$ to denote the meaning or intension of a closed sentence ϕ in a model M , relative to a conceptual perspective \wp .

1.4.4. DEFINITION. [Answers under Cover] Let ψ and $?x\phi$ be closed sentences in QL_{CC} .

1. ψ is a (partial) answer to $?x\phi$ in M under \wp , $\psi \triangleright_{M,\wp} ?x\phi$, iff

$$\exists X \subset \llbracket ?x\phi \rrbracket_M^\wp : \llbracket \psi \rrbracket_M^\wp = \cup \{\alpha \mid \alpha \in X\} \neq \emptyset$$

2. ψ is a complete answer to $?x\phi$ in M under \wp , $\psi \text{ }_c\triangleright_{M,\wp} ?x\phi$, iff

$$\llbracket \psi \rrbracket_M^\wp \in \llbracket ?x\phi \rrbracket_M^\wp$$

The dilemma discussed above is solved. On the one hand, problems of identification can be represented as problems of mapping elements from different covers onto each other. It depends on the perspective assumed whether an identity question is a vacuous move.

1.4.5. FACT. [Perspectives and Triviality]

$$?x \ t = x \text{ is trivial in } M \text{ under } \wp \Leftrightarrow \lambda w \ [t]_{M,w} \in \wp(x)$$

We assume that choices of \wp which render questions vacuous are ruled out by general conversational principles.²³ We can thus account for the fact that ‘Eduard is Eduard’ hardly counts as an adequate answer to ‘Who is Eduard?’. The latter, if genuine, asks to map the concept *Eduard* to an element of a conceptualization which crucially does not include it.

On the other hand, terms from which answers are built up need not be rigid designators. It suffices that their interpretations are elements of the assumed methods of identification. We can then account for the difference between the question-answer pairs in examples (A), (B) and (C) in section 1.3.1:

1.4.6. FACT. [Perspectives and Answerhood] Let M be a standard model and $p \neq q$. Then

$$(A) \ \forall \wp : \lambda w \ [t]_{M,w} \in \wp(x) \Leftrightarrow (!)Pt_{(c)} \triangleright_{M,\wp} ?xPx;$$

$$(B) \ \forall \wp : q_{(c)} \not\triangleright_{M,\wp} ?p;$$

$$(C) \ \forall \wp : p_{(c)} \triangleright_{M,\wp} ?p.$$

‘Eduard called’ counts as an appropriate answer to ‘Who called?’ if and only if the interpretation of ‘Eduard’ is part of the assumed conceptual cover (cf. (A)). Although they are context dependent, who-questions and their answers are clearly distinguished from highly marked pairs such as ‘Is it raining? - I am going to the cinema’. The adequacy of the former depends on the perspective assumed, the correctness of the latter relies on the factual information presupposed (cf. (B)). Standard pairs such as ‘Is it raining? - It is raining’ are always correct irrespective of the circumstances of the utterance (cf. (C)).

Finally, notice that our analysis allows the characterization of a notion of knowing-who that is relative to a perspective \wp : a sentence like ‘ a knows $?x\phi$ ’ is true in w under \wp iff a stands in the *know*-relation to $\llbracket ?x\phi \rrbracket_w^\wp$ in w , i.e. iff a believes the true complete answer to the question under \wp . In this way, we can account for the context sensitivity of knowing-who constructions illustrated by the Spiderman case discussed in section 1.3.2.

1.5 Other Semantic Theories of Questions

In this section, I show that the present analysis does not only apply to the G&S theory of questions, but can also be exported to other frameworks.²⁴ In particular, I will consider the proposition set theory (section 1.5.1) and the structured

²³See chapter 4.

²⁴See Ginzburg (1996), Higginbotham (1996), and Groenendijk and Stokhof (1997) for recent and exhaustive overviews.

meaning theory (section 1.5.2). In the last section, I discuss Ginzburg's pragmatic analysis and compare my account with his explanation of the fact that different contexts require different answers.

Recall Hamblin's three postulates presented at the beginning of section 1.2, repeated here:

- A To know the meaning of a question is to know what counts as an answer to that question.
- B An answer is a statement.
- C The possible answers to a question form an exhaustive set of mutually exclusive possibilities.

All of the semantic analyses of questions I will consider satisfy the first principle. A theory of questions should provide an account of the answers that an interrogative allows, and this is obtained by relating the meaning of questions to the meaning of their answers.²⁵ As we saw, approaches that interpret questions as determining **partitions** of the logical space (e.g. G&S (1983, 1997), Higginbotham and May (1981))²⁶ define the meaning of questions in terms of their *complete* answers and therefore accept all of the three Hamblin postulates given above. The two theories I am going to discuss, the proposition set theory and the structured meaning approach, assume different notions of a possible answer as primary, and so reject one or the other of the Hamblin principles, viz. C and B respectively.

1.5.1 Proposition Set Theory

The sets of propositions theory goes back to Hamblin (1973)²⁷ and Karttunen (1977), and constitutes one of the most influential theory among the linguistic account of questions. Such an analysis states the meaning of an interrogative in terms of the meaning of what I will call its *singular positive* answers. Singular positive answers are answers that fill in a referential constituent for the *wh*-word in the question and do nothing else. According to these theories, questions are sets of propositions (postulate B), representing the possible singular positive answers to the question (postulate A). However, the latter do *not* form an exhaustive set of mutually exclusive possibilities (postulate C is rejected). In the analysis of

²⁵See Hintikka (1976) for an example of a theory which does not define the meaning of interrogatives in terms of the meaning of their answers.

²⁶See Groenendijk and Stokhof (1997), pp. 1103-1104, for a comparison between their analysis and Higginbotham and May (1981).

²⁷As noted by Groenendijk and Stokhof (1997), Hamblin (1973) does not satisfies the postulates formulated in Hamblin (1958).

Karttunen,²⁸ questions are analyzed as follows (recall that by $\vec{\alpha}$ I mean sequences $\alpha_1, \dots, \alpha_n$):²⁹

1.5.1. DEFINITION. [Karttunen]

(i) yes-no question:

$$_K\llbracket ?\phi \rrbracket_{M,w,g} = \{p \mid (p = \llbracket \phi \rrbracket_M \vee p = \llbracket \neg\phi \rrbracket_M) \ \& \ w \in p\}$$

(ii) constituent question:

$$_K\llbracket ?\vec{x}\phi \rrbracket_{M,w,g} = \{\lambda v \llbracket \phi \rrbracket_{M,v,g[\vec{x}/\vec{d}]} \mid \vec{d} \in D^n \ \& \ \llbracket \phi \rrbracket_{M,w,g[\vec{x}/\vec{d}]} = 1\}$$

The denotation of a question in a world is identified with a set of propositions, rather than with a set of worlds as in the G&S analysis. An interrogative like ‘Did John call?’ denotes in world w the set containing the proposition *that John called*, if John called in w or *that John did not call* otherwise. An interrogative like ‘Who called?’ denotes in w the set consisting of those propositions which are true in w and which say of some individual that (s)he called: $\{that \text{ John called, that Mary called, that Bill called, } \dots\}$. While in the G&S logic, meanings of constituent questions were characterized as a set of mutually exclusive propositions, here their denotations are identified with a set of mutually compatible possibilities.³⁰

²⁸The difference between the Hamblin and the Karttunen analysis is that according to Hamblin, interrogatives denote the set of all their possible singular answers, whereas Karttunen takes them to denote the set of all *true* singular answers. The reason of this modification has to do with the interpretation of (a) sentences like ‘Who is elected depends on who is running’, which can be paraphrased as ‘the *true* answer to the former question depends on the *true* answer to the latter question’; and (b) question embedding verbs like *tell*, *indicate*, which become factive if they take a question complement.

²⁹Here I consider only who-questions and ignore which-questions. For these the Karttunen analysis differs from the G&S analysis on a further aspect. See footnote 33.

³⁰It has been argued that this feature of the set of proposition theory can be useful to account for the so-called *mention-some* interpretations of constituent questions. In certain situations, interrogatives do have a number of fully adequate and mutually *compatible* answers. Consider the following sentence uttered by a tourist in Amsterdam (this example is due to G&S):

(23) Where can I buy an Italian newspaper?

Intuitively (23) can be *completely* resolved by an answer that mentions *some* places in which Italian newspapers are sold, thus a positive (possibly plural) answer, rather than a complete answer, as predicted by the G&S analysis, which provides a full specification of *all* such places. Note, however, that the contrast between mention-some and mention-all interpretations is still not totally understood and it seems that the Karttunen theory would need non-trivial amendments in order to properly account for it. See van Rooy (1999) and van Rooy (2000b) for a recent and interesting analysis of these phenomena. Robert van Rooy’s account is based on the assumption that questions are asked in order to resolve decision problems. This view gives an explanation of the fact that certain types of responses can intuitively resolve a question like (23), although the standard partition semantics approach predicts that they cannot.

Since many of the examples we have considered in this chapter involve embedded uses of interrogative sentences,³¹ let us see now how these can be treated in the proposition set theory. Karttunen proposes the following analysis of knowing-wh constructions: in order for a sentence like ‘*a* knows *Q*’ to be true in *w*, the subject has to believe in *w* every proposition in the denotation of the embedded question in *w*. This analysis leads to a number of counter-intuitive results³² the most striking one is that a sentence like ‘John knows whether Bill called’ would not be entailed by a sentence like ‘John knows who called’. In order to remedy these inadequacies, Heim (1994) proposes the following amendment for the lexical semantics of *know* in a proposition set framework: a sentence like ‘*a* knows *Q*’ is true in *w* iff *a* believes in *w* the proposition $\lambda w'[\llbracket Q \rrbracket_{M,w'} = \llbracket Q \rrbracket_{M,w}]$. In order for a wh-knowledge attribution to be true in *w*, the subject’s belief state must contain only worlds in which the embedded question receives exactly the same Karttunen denotation as in *w*. For instance, ‘John knows who called’ is true iff John’s belief state is a subset of the set of worlds in which the same set of individuals called as in the world of evaluation, that is, iff John believes the true complete answer to the question. For who-questions, Heim’s proposal manages to match the correct predictions of the partition theory,³³ therefore we will assume it in the following discussion.

It is easy to see that this Karttunen-Heim analysis of questions leads to precisely the same difficulties as the G&S theory in connection with the phenomena discussed in this chapter.

First of all, the dilemma presented in section 1.3.1 arises here as well. Clearly, on Karttunen’s account, only replies employing rigid terms can count as answers to constituent questions and identity questions concerning rigid terms are trivial, since their only possible answers are tautologies. Recall that the notion of an answer directly definable here is that of a positive singular answer:

1.5.2. DEFINITION. [K-Answers] ψ is a (singular positive) *answer* to $?x\phi$ in *M*, $\psi \llbracket_K \triangleright_M ?x\phi$, iff

$$\exists w, g : \llbracket \phi \rrbracket_M \in \llbracket ?x\psi \rrbracket_{M,w,g}$$

³¹In particular, the choice of taking conceptual covers as domains of quantification for wh-expressions rather than randomly collected sets of concepts are better motivated in connection to embedded uses of questions whose interpretation involves a universal quantification over these concepts (recall the arguments in section 1.4.3).

³²See Groenendijk and Stokhof (1984) for a detailed discussion of these difficulties.

³³The match is not perfect though and problems arise in connection with which-questions, as noted by Heim herself, who proposes an enriched variant of the Karttunen analysis as a solution which employs structured propositions. I will disregard this issue, which, although interesting, is not relevant to the main theme of this work. Note that the interpretation of which-questions constitutes a problem for most existing approaches, which fail to account properly for their ‘asymmetric nature’ (e.g. ‘Which men are bachelors?’ \neq ‘Which bachelors are men?’).

The notion of a trivial question can be characterized in Karttunen's theory as follows: a question is trivial in $M = \langle D, W \rangle$ iff its denotation in some w in W is the singleton set containing the trivial proposition W . The following two facts clearly hold:³⁴

1.5.3. FACT. [K-Answerhood and Rigidity] Let $M = \langle D, W \rangle$ be a standard model.

$$Pt_K \triangleright_M ?xPx \Leftrightarrow t \text{ is rigid in } M$$

1.5.4. FACT. [Rigidity and Triviality] Also in K :

$$t \text{ is rigid in } M \Leftrightarrow ?x x = t \text{ is trivial in } M$$

Furthermore, the Karttunen-Heim analysis, as it stands, simply ignores the various pragmatic factors that play a role in determining what counts as a good or a bad answer in different contexts. Therefore, it cannot account for the Konare or Spiderman cases, nor for the variability illustrated by the workshop examples. As a remedy to this, we can adopt the same strategy we adopted for the G&S analysis, namely we make wh-expressions range over elements of conceptual covers rather than over individuals of the domain. As above, special indices ranging over covers are added to the variables in the language, whose value is determined by conceptual perspectives \wp . The interpretation of wh-interrogative sentences is relativized to these perspectives:

1.5.5. DEFINITION. [Karttunen under Cover]

$${}_K \llbracket ?\vec{x}\phi \rrbracket_{M,w,g}^\wp = \{ \lambda v \llbracket \phi \rrbracket_{M,v,g[\vec{x}/\vec{c}(v)]} \mid \vec{c} \in \prod_{i \in n} (\wp(x_i)) \ \& \ \llbracket \phi \rrbracket_{M,w,g[\vec{x}/\vec{c}(v)]} = 1 \}$$

From this definition, assuming Heim's semantics for *know*, we obtain a perspective relative notion of knowing-who constructions and thus we can account for the Spiderman case: '*a* knows *Q*' is true in *w* under \wp iff *a* believes in *w* the proposition $\lambda w' [{}_K \llbracket Q \rrbracket_{M,w'}^\wp = {}_K \llbracket Q \rrbracket_{M,w}^\wp]$.

The alternative possibility of letting wh-expressions range over arbitrary sets of salient concepts, rather than conceptual covers would lead here to the same counter-intuitive results discussed in section 1.4.3 for the relation between knowing-who and knowing-how-many constructions.

³⁴The proof of the first fact is in the Appendix. The proof of the second fact is trivial.

1.5.2 Structured Meaning Theory

The Structured Meaning or Categorical Theory of questions originates in the work of Ajdukiewicz in the late 20s and was further developed by among others Tichy (1978), Hausser and Zaeffer (1979), von Stechow and Zimmermann (1984), von Stechow (1990) and more recently Krifka (1999). Such a theory analyzes questions in terms of their answers (postulate A). It does not assume, however, that answers do belong to a uniform category (postulate B which states that answers are sentences is rejected). Sub-sentential answers, often called *constituent* or term answers, play a crucial role in the structured meaning analysis. The category of an interrogative is chosen in such a way that in combination with the category of its constituent answers it yields the category of indicative sentences. As a result different kinds of interrogatives are of different categories and semantic types. In Krifka (1999), questions are defined as functions that when applied to the meaning of the possible constituent answers, yield the meaning of the corresponding full sentential answers. Polar questions expect ‘yes’ or ‘no’ as constituent answers, which are analyzed as propositional operators of type $\langle t, t \rangle$ ³⁵ which retain or reverse the truth value of the proposition respectively. Yes-no questions are then expressions of type $\langle \langle t, t \rangle, t \rangle$. For example:

(24) Q: Is it raining? $\lambda f[f(p)]$

A: No. $\lambda q[\neg q]$

Q(A): It is not raining. $\lambda f[f(p)](\lambda q[\neg q]) = \neg p$

Instead, single wh-questions take singular noun phrases as constituent answers, whose semantic type is e , that of expressions referring to entities.³⁶ They are then assigned the type $\langle e, t \rangle$. For example:

(25) Q: Who called? $\lambda x[P(x)]$

A: Mary. m

Q(A): Mary called. $\lambda x[P(x)](m) = P(m)$

One advantage of the categorical approach over theories which analyze questions in terms of sets of propositions has to do with the interpretation of alternative polarity questions (see Krifka (1999)).³⁷ Both the Karttunen or the G&S

³⁵Krifka assumes an extensional type theory. In an intensional type theory they would be of type $\langle \langle s, t \rangle, t \rangle$.

³⁶Sometimes the type of a generalized quantifier is assumed for constituent answers to wh-questions.

³⁷It has been argued that a further advantage of a structured meaning approach is that it allows a straightforward account of the information structure in answers (see again Krifka

analysis cannot distinguish between the following two questions which are assigned the same denotation if the former is interpreted as a polarity question. A categorial approach, instead, can account for the fact that they allow different answers:

(26) Q: Do you like Milan, or don't you? $\lambda p[p = L(m, y) \vee p = \neg L(m, y)]$ (type: $\langle t, t \rangle$)

A: I don't. $\neg L(m, y)$ (type: t)

(27) Q: Do you like Milan? $\lambda f[f(L(m, y))]$ (type: $\langle \langle t, t \rangle, t \rangle$)

A: No. $\lambda q[\neg q]$ (type: $\langle t, t \rangle$)

Less straightforward, however, is the structured meaning analysis of embedded questions. The fact that interrogatives are not assigned a uniform semantic type requires the assumption of special lexical rules for the various question embedding verbs, since the latter can take (coordinations of) interrogatives belonging to different categories. Krifka (1999) proposes the following entry for *know*, which reduces knowing-wh to knowing-that constructions: *a* knows *Q* iff for every full answer *A* that answers *Q*, if *A* is true then *a* knows that *A*, if *A* is not true then *a* knows that not *A*. Recall that full answers are the result of the application of the question to the term answers. For example, 'Mary called' is a full answer to the question 'Who called?'.

It is easy to see that the difficulties emerging for the G&S and the Karttunen analyses arise in the structured meaning theory as well, although in a different form. Note first of all that all expressions belonging to the right category (e.g. all replies in (28b), which are of the required type *e*) seem to be accepted as answers, so there is no strict link between rigidity of terms and the notion of answerhood:

(28) a. Who is the president of the United States?

- b. - Bill Clinton.
- That guy [pointing at Clinton].
- Hillary's husband.
- Donald Duck.
- That guy [pointing at Donald Duck].
- Uncle Scroodge's nephew.

(1999)). Note, however, that the topic-focus structure in answers can be accounted also by analyses which assume a proposition set or a partition interpretation for questions. See for example Roberts (1996b) which assumes a Rooth style representation of focus (cf. Rooth (1992)) and a proposition set analysis of questions; and the recent Aloni et al. (1999) which interprets intonation in terms of presupposition of topics under discussion and questions (or explicit topics) as domain restrictions which uniquely determine partitions of the logical space.

A first consequence of this is that the categorial approach, as it stands, cannot explain why different circumstances require different answers employing different methods of identification for the objects in the universe (see the Priscilla case). A further consequence has to do with embedded uses of questions. Note that on Krifka's account, as far as I understand it, in order for the following sentence to be true:

(29) Priscilla knows who the president of the United States is.

Priscilla would have to know, for every full answer A to (28a), that A is true, if A is true, and that A is false, otherwise. Thus (29) would be judged false in a situation in which Priscilla knows that Bill Clinton is the president, but cannot recall whether he is Hillary's husband or Uncle Scroodge's nephew. The problem is that *know* is taken to quantify, universally, over the set of all structurally acceptable answers, while it should clearly quantify only over *good* answers.³⁸ The categorial approach, as it stands, clearly lacks a characterization of what counts as a good answer to a question in a specific context. The most straightforward way to amend it consists in letting (multi-)constituent questions take as constituent answers (sequences of) expressions of the category of individual concepts (of type $\langle s, e \rangle$) rather than entities (of type e) and then let the contextually operative conceptual covers restrict the domain of application of the function expressing the question meaning. Again we add special *CC*-indices to the variables of the language and let conceptual perspectives \wp determine their value. A sequence of singular terms t_1, \dots, t_n will be a *good* term answer to a (multi-)constituent question $\lambda \vec{x} \phi(\vee \vec{x})$ under \wp iff for all $i \in n$, the interpretation of t_i in the model is an element of $\wp(x_i)$. Good full answers result from applying questions to good constituent answers. We then obtain that John knows Q under \wp iff for every good full answer A to Q under \wp , if A is true then John knows that A , if A is not true then John knows that not A . Again, the choice of taking conceptual covers rather than arbitrary sets of concepts is crucial, in particular for the interpretation of knowing-who constructions which involve universal quantification over these concepts (see again the arguments in section 1.4.3).

1.5.3 Pragmatic Theory

Recently, the issue of the context sensitivity of questions has received new attention in the linguistic literature in the work of Jonathan Ginzburg. In order

³⁸Krifka observes that 'non-exhaustive' interpretation of *know* (see Berman (1991)) can be captured in his analysis, by positing that knowing *some* answers to Q may be sufficient in order to know Q in certain circumstances, with the universal quantification over answers being just the default option. Note, however, that the cases I am discussing here do not involve non-exhaustive interpretations in the sense of Berman (1991), but rather exhaustive interpretations which intuitively involve universal rather than existential quantification, but not over all structurally acceptable answers, but over a specific subset of them.

to account for the influence of pragmatic factors on the interpretation of questions and answers, Ginzburg (1995) proposes what he calls a *relative* notion of an answer resolving a question. In his theory, questions are analyzed as in the structured meaning approach (though in the framework of situation semantics, rather than possible world semantics); extensional question-embedding verbs are analyzed as imposing a resolvedness condition on their interrogative complement and what counts as resolving crucially depends on contextual parameters, such as the goals and inferential capabilities of the questioner. The Spiderman case discussed above could then be analyzed roughly as follows. Recall the relevant situation. Someone killed Spiderman. In context γ , you are at the police department investigating the murder. In context δ , you are at a ball with the intention to arrest the culprit. In the two contexts, you are after two different goals. A goal can be described by a proposition, intuitively, the proposition that is true once the goal desired by the relevant agent is fulfilled. Going back to the Spiderman example this means:

goal in γ = You know the name of the culprit.

goal in δ = You know what the culprit looks like.

In the situation described, (30) below is true in both contexts. The proposition expressing the goal in γ can be ‘inferred’ from (30), but the one expressing the goal in δ cannot. So, (31) is true in one context and false in the other.

(30) You know that John Smith killed Spiderman.

(31) You know who killed Spiderman.

However, once we try to formalize this analysis we get into problems. According to the theory of rigid reference, which Ginzburg seems to adopt, the following two propositions are still equivalent:

(32) John Smith killed Spiderman.

(33) He [pointing at John Smith] killed Spiderman.

Hence it is not clear how (30) and (34) can have different implications:

(34) You know that he [pointing at John Smith] killed Spiderman.

The simple introduction of goals and perspectives as explicit parameters of the answerhood relation is not sufficient to explain the phenomenon I discussed here and needs to be combined with a more sophisticated account of how objects are identified in cognitive states. Identification under conceptual covers gives the required ingredients for such an account.

Furthermore, in this chapter, I have also showed a different way of formalizing the same idea that goals and perspectives are relevant for an analysis of questions. On Ginzburg's approach, different answers resolve, in different contexts, an interrogative whose meaning stays constant. In my analysis, an interrogative expresses different partitions in different contexts, because in different contexts different domains of quantification are selected for the *wh*-expression. In Ginzburg's theory, goals and perspectives are parameters of the answerhood relation, here they play a role in selecting a domain of quantification. Consider Ginzburg's argument in favor of his division of labor (see Ginzburg (1995), pp. 170-171). He distinguishes two ways in which misunderstanding can arise in a dialogue, one arising from failure to communicate a content, the other from failure to share a 'perspective'. He uses the following examples to illustrate this contrast:

- (35) a. A: John left.
 B: No, look, he's sitting outside, chatting up Milena.
 A: I meant John Schwitters.
- b. A: Everyone will support the decision.
 B: Including the CS people?
 A: I meant every linguist.
- (36) A: [yawns] That was a boring talk.
 B: No, it wasn't.

In (35) B fails to grasp a content. In (36) the participants fail to share a 'perspective'. An exchange such as (36) can be explained 'by saying "boredom is relative", that is, by positing that the relation denoted by the use of "boring" in (36) has an additional 'perspectival' argument which is filled by, say, a mental state of an agent. In contrast to (35), where the impasse in the conversation can be repaired by agreeing on a single way to fix the contextual parameter (establishing what the domain of quantification is), there is no such requirement with (36) where the disagreement can be patched up with each conversationalist still holding on to his perspective' (Ginzburg (1995), pp. 170-171). Ginzburg then argues that the context dependency of questions and answers resembles more the perspectival mismatch in (36) than the semantic mismatch in (35), and hence is better captured by assuming a relative notion of resolvedness rather than by adopting the domain-selection strategy. My claim, in relation to the phenomena I have been discussing in this chapter, is exactly the opposite. Although some of the examples of context sensitivity discussed by Ginzburg may be cases of perspectival mismatch, the cases of dependence on the method of identification that I have considered here are more similar to cases of semantic mismatch. As an illustration, observe the close resemblance between the dialogues in (35) and the following dialogue:

(37) A: Who is the president of Mali?

B: That [pointing at someone] is the president of Mali.

A: I meant, what is his name.

In this example, as in (35) and in contrast with (36), the misunderstanding between A and B is totally resolved by A's remark and it would be weird for B to hold on her own perspective. Although a certain degree of vagueness and 'perspectival' factors might play a role in connection to the general notion of what counts as a good answer to a question in a specific context, I conclude that the cases I have been discussing in this chapter are better captured by assuming that different contexts select different quantificational domains for the *wh*-phrase, rather than by simply positing an additional contextual or perspectival argument on the notion of resolvedness. A clear advantage of the former strategy is that it allows a straightforward account of the fact that the described context sensitivity is specific of constituent questions and their answers,³⁹ an analysis of these cases in the style of Ginzburg's would lack a natural explanation of this fact. Furthermore, the context dependency of quantificational domains is a pervasive phenomenon in natural language, and it is not surprising that it arises with *wh*-expressions as well. Recall, however, that the domain selection I discuss here is somehow different from the one normally recognized (see Westerståhl (1984)). The context does not only decide on which set of objects is salient at the moment of the utterance, but also on which ways of identifying the salient objects are relevant and should be taken into account.

1.6 Conclusion

A domain of individuals can be observed from different angles. Our interpretation of *who*-questions and their answers may vary relative to which ways of identifying objects we assume. By letting *wh*-expressions range over elements of conceptual covers, we can account for this variability while maintaining the intuitive characterization of constituent questions as asking for the specification of a set of determinate individuals. The elements of a cover do not stand for representations of individuals but rather for the individuals themselves but identified in a particular way.

³⁹The context dependency of polar questions and their answers is of a different kind and can be better captured by an information-dependent notion of an answer (see section 1.3.1).