Worksheet - Word order in questions with do/does

Put the words into the correct columns and form questions. Always use the auxiliary do or does.

How to work with the table

- Underline all verbs in the following lines ***(sentence 1: like)*** and write these words into the column **Verbs**.
- Look for the subject of the sentence ***(sentence 1: you)*** and write it into the column **Subject**.
- Then write ***do*** or ***does*** into the column **Auxiliary** (use does with he - she - it; use do with I, you, we, they) ***(sentence 1: do -> because of you)***.
- Then write the question word into the first column (if there is none, write ---) ***(sentence 1: no question word, write ---)***.
- Write all the remaining words into the column **Object - Place - Time *(sentence 1: English)***.

1) like / you / English
2) play / he / football
3) read / they / books
4) when / go / the boys / to school
5) why / you / smoke
6) check / teacher / your homework
7) Bill / when / get up / in the morning
8) drink / you / milk
9) where / your father / live
10) what / sell / Max
11) your mother / do / the shopping
12) when / we / meet
13) why / in front of the school / they /wait
14) computer games / play / Fred
15) the Robinsons / how / live
16) Andrew / have / what hobbies
17) rain / it / a lot in England
18) like / which picture / best / you
19) a cup of coffee / the girls / in the morning / have
20) who / Doris / phone

	Question word	***Auxiliary***	***Subject***	***Verb***	***Object - Place - Time***
1	---	Do	you	like	English?
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					

Simple Present (interrogative)

1. Write questions as in the example.

1. *You / speak English.* *Do you speak English?*
2. She / work hard.
3. They / have dinner at eight
4. Jill and Tom / study at university
5. You / do your homework every day
6. John / watch TV after dinner.
7. He / wash the car at the weekend.
8. Her friends / live in London.
9. You / have any brothers or sisters.
10. Your friends / go to the cinema very often.

2. Complete the questions with *do* or *does*.

1. ..... she take her gog for a walk in the morning?
2. ..... your friend Paul work in the shop over there?
3. ..... they know the answers to the exam?
4. ..... your parents know that you smoke?
5. ..... Bill teach maths?
6. Where ..... your sister live?
7. What time ..... the lessons finish?
8. ..... you go to the coast in summer?
9. ..... it rain very often in Ireland?
10. Why ..... they ask so many questions in class?

3. Write short answers to these questions (yes, I do / no, I don´t / yes, she does / no, she doesn´t, ...)

1. Do you speak French? .....
2. Does your mother like chocolate? .....
3. Do you study a lot? .....
4. Do you usually watch TV at night? .....
5. Do you play a musical instrument? .....
6. Does your father work? .....
7. Do you go to the cinema? .....
8. Does your best friend study? .....
9. Does it rain a lot in Africa? .....
10. Do you live in a flat? .....

Answers

Exercise 1:

2. Does she work hard?
3. Do they have dinner at eight?
4. Do Jill and Tom study at university?
5. Do you do your homework every day?
6. Does John watch TV after dinner?
7. Does he wash the car at the weekend?
8. Do her friends live in London?
9. Do you have any brothers or sisters?
10. Do your friends go to the cinema very often?

Exercise 2:

1. Does she take her gog for a walk in the morning?
2. Does your friend Paul work in the shop over there?
3. Do they know the answers to the exam?
4. Do your parents know that you smoke?
5. Does Bill teach maths?
6. Where does your sister live?
7. What time do the lessons finish?
8. Do you go to the coast in summer?
9. Does it rain very often in Ireland?
10. Why do they ask so many questions in class?

Exercise 3:

1. Yes, I do / No, I don´t
2. Yes, she does / no, she doesn´t
3. Yes, I do / No, I don´t
4. Yes, I do / No, I don´t
5. Yes, I do / No, I don´t
6. Yes, he does / No, he doesn´t
7. Yes, I do / No, I don´t
8. Yes, she/he does // No, she/he doesn´t
9. Yes, it does / No, it doesn´t.
10. Yes, I do / No, I don´t

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9. Does it rain a lot in Africa? .....
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CHAPTER 19

Questions

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1. Preliminary

In common parlance, the term *question* is used in at least three different ways, which, in order to avoid misunderstanding, will be distinguished terminologically in this chapter. First of all, the term may be used to refer to a particular type of sentences, characterized (in English) by word order, intonation, question mark, the occurrence of interrogative pronouns. In the sequel such sentences will be referred to by the term *interrogative sentences*, or *interrogatives* for short. Another way of using the term *question* is to refer to the speech act that is typically performed in uttering interrogative sentences, i.e., to denote a request to an addressee to provide the speaker with certain information, a request to answer the question. The phrase *interrogative act* will be used to refer to such speech acts. An interrogative act can be described as the act of asking a question. In this description a third use is made of the term *question*, viz., the one in which it refers to the 'thing' which is being asked, and which, as a consequence, may be (partially) answered. This object can be viewed as the semantic content, or sense, of an interrogative. In what follows, the term *question* will be reserved exclusively for this latter use. Of course, several people have doubted that there are such things as questions in this restricted sense of the word. To establish that there are, and to argue that they constitute the primary domain for a logical and semantical theory is one of the main aims of this chapter.

It should be noted at the outset that although questions are typically asked and answered, one can also do a lot of other things with them: one can discuss them, wonder about them, formulate them, etc. Such acts are typically reported by indicative sentences. Hence questions are not exclusively tied to either interrogative sentences, or to the speech act of asking a question. Note furthermore that an interrogative sentence need not always be used to ask a question, i.e., to perform an interrogative act, witness so-called 'rethorical questions'. And questions can also be asked by other means than through the use of interrogative sentences. Example: 'Please, tell me why there is something rather than nothing.' Or: 'I hereby request you to let me know why there is something rather than nothing.' Similar observations pertain to answers, by the way: an answer may, but need not be expressed by an indicative sentence. So-called 'rethorical questions' are not interrogative but assertive acts, and are often used to formulate an answer to a question.

Be that as it may, the relation between interrogatives and questions is obviously more than coincidental: in reality it is pretty hard to ask questions without using interrogatives at some points. And likewise, answering a question without the use of indicatives seems not to be the default case. A proper theory of the meaning and use of interrogatives should account for this.

Just like indicative sentences, interrogatives come in two forms: on their own, and embedded. The former are often referred to as 'stand alone' interrogatives. Note that in the examples just given, in which a question is asked by means of a sentence in the imperative mood or in the indicative mood, rather than by the use of a proper interrogative, embedded interrogatives occurred. If it is assumed that both stand alone and embedded interrogatives express questions, then questions are

around also when the speech act of asking a question is made by non-interrogative means.

This points towards the existence of questions as a separate kind of entity, to be distinguished both from the linguistic object that an interrogative sentence is, and from the pragmatic entity that the act of asking a question constitutes. No one will deny the reality of the latter kinds of entities, but, as was already remarked above, for various reasons many have disputed the existence of questions as a separate semantic category. The study of interrogative sentences obviously belongs to the syntactic part of linguistics, and the study of interrogative acts to that of pragmatics, in particular to speech act theory. Questions, conceived of as is done here, i.e., as the senses of interrogative sentences, or as the contents of interrogative acts, would constitute the domain of a semantics, or logic, of questions. But the existence of this realm is yet to be established.

2. Setting the stage

The semantics of interrogatives is a strange affair. It seems fair to say that in a sense it is an underdeveloped part of natural language semantics. Part of the reason for that, it seems, is that there is no standard framework that is generally acknowledged as providing a common starting point for semantic analyses of various phenomena within the field. No set of concepts exists that can be used to formulate and compare rival analyses. In fact, there even seems no clear communis opinio on what constitutes the subject of investigation in the first place. Clearly this forms a stumbling block for real progress.

For indicative sentences such a common framework is available, viz., that of some variety of denotational semantics. This framework provides some starting points and concepts that various analyses can exploit, even when they want to deviate from it. In other words, denotational semantics provides us with a picture, which can be applied, filled in, modified (up to distortion, in some cases), and so on. Elements of the picture are familiar, almost 'common sense' ideas such as the following. The meaning of a sentence is given by its truth conditions. The meaning of subsentential expressions resides in the contribution they make to the meanings of sentences. Synonymy is identity of meaning, entailment comes down to inclusion of meaning. Thus this framework establishes the reality of certain types of objects and of certain relationships between them. The term *proposition* is generally used to refer to the truth conditional content of a sentence. Likewise, *property* refers to the content of a predicative expression, and so on.

Calling denotational semantics a 'common framework' does not imply that everyone subscribes to it in all details. However, it is important to note that even those who challenge the established view, e.g., the situation semanticists, or the dynamic semanticists, acknowledge that traditional denotational semantics provides a viable framework which is adequate as a semantic theory for at least a certain variety of formal languages and for interesting fragments of natural language. Few would deny that, e.g., first order logic and its standard semantics, or possible worlds semantics

for modal predicate logic, are systems that give useful and interesting insights in certain aspects of the meaning of central parts of language, including natural language. It is in this sense that classical denotational semantics provides a common frame of reference for sometimes radically divergent alternative views. It is precisely such a common frame of reference that seems to be lacking when one switches from the analysis of indicatives to that of interrogatives.

The difference seems to lie in this, that in discussing indicatives a distinction is made between the contents of a sentence and the act that is performed by uttering it, with no questions asked.[1] One is usually not bothered by the fact that indicative sentences are typically, though not exclusively, used by speakers to make assertions, to inform hearers, and so on. That is to say, one abstracts away from the (typical) use of indicatives, assuming that their contents can be studied (relatively) independently. Likewise, the specific goals that speakers try to achieve in making assertions, and the strategies they follow in doing so, are considered to be irrelevant in that respect, too. One may acknowledge the importance of these issues from the point of view of an overall theory of language use, and nevertheless consider it justified to abstract away from these pragmatic aspects of meaning, and to concentrate on the informative, propositional content of indicative sentences as such.

When one comes to consider the semantics of interrogatives, however, this perspective is *not* generally adopted. One of the reasons may be the following. By and large, formal semanticists have directed their attention almost exclusively to the analysis of indicatives. In this their enterprise bears the traces of its logical ancestry. Certainly this may have given people—proponents and opponents alike—the impression that the notions of truth and falsity are at the heart of logical semantics. Observing that these notions indeed do not apply to non-assertive uses of language, some have rushed to the conclusion that the semantics of sentence types that are typically employed in performing non-assertive speech acts, are outside the reach of logical semantics, which would be reason enough to doubt its viability as (part of) an overall theory of natural language meaning.

Others, who would like to deny this conclusion, but who share the assumption on which it is based, have seen themselves forced to somehow 'reduce' non-indicatives to indicatives. One popular line of defense is that logical semantics can ignore non-indicatives, precisely because logic is only concerned with propositional content, and the content of an interrogative is a proposition just like that of an indicative. Indicatives and interrogatives, it is claimed, have a different mood, but their logical content is the same. The (unmistakable) difference between the two is not one of meaning, i.e., a matter of semantics, but solely one of use, i.e., it belongs to pragmatics. There are several variants of this type of parrying questions, but, as will be argued below, none of them is very convincing. For one thing, such reductionist' approaches do not do justice to the fact that whereas indicatives[2] can be said to be true or false irrespective of the particular use they are put to, this does not

[1] Nowadays, that is. But the distinction did present a problem to Frege, who wrestled with the difference between asserted and non-asserted propositions, and distinguished them notationally in his Begriffsschrift.

[2] Barring perhaps explicit performative sentences.

hold for interrogatives. Yet, in the case of the latter, too, there are aspects of content which can be separated from the particular ways in which they are used. If this observation is correct, a reduction of (the contents of) interrogatives to (the contents of) indicatives is fundamentally on the wrong track.

Where does this leave one? It seems that in order to argue that the development of a logical semantics of interrogatives is a viable enterprise, two views must be shown to be inadequate: one that says that they can be analyzed fruitfully only at the level of interrogative acts, and one that holds that there is no significant difference between indicatives and interrogatives, at least as far as semantic content is concerned. It is important to note that one may hold both views at the same time. Specifically, one may adduce the second view as an argument for holding the first.

If the proper arguments against these positions can be produced, this will in effect show *ex negativo* that a separate domain of questions, in the technical sense introduced above, exists. A subsequent task is to approach this domain in a more positive way, i.e., to give an indication of the phenomena that a semantics of interrogatives has to deal with, to outline various approaches that have been tried, and to provide an assessment of the main results.

By and large, it is by such considerations that the remainder of this chapter is organized. First the pragmatic view, that interrogatives can be studied fruitfully only at the level of speech acts, is considered and scrutinized. The approach here is mainly direct. An attempt is made to show that this view in effect presupposes a semantic theory of questions. The other line of reasoning, according to which there are no semantic differences between indicatives and non-indicatives, is dealt with along the way, in a more indirect fashion. Various theories that instantiate aspects of the pragmatic view are briefly characterized and discussed, but since our main interest is systematic and not historic, we focus on one particular instance.

Then we move to a discussion of semantic views. First we sketch an approach that starts out from some rather strict postulates concerning interrogatives and answers. The adequacy of the result is discussed with reference to some general methodological considerations. Then a similar kind of view is developed from a different starting point. First we consider whether, and if so how, interrogatives can be added to the language of propositional logic. One of the results of this investigation establishes the essentially intensional nature of the notion of a question. Next we consider the addition of interrogatives to the language of predicate logic, and show that, given some general requirements, the resulting analysis resembles the approach developed earlier in important respects. After a brief discussion of the the goals and characteristic issues of logical and computational approaches we turn to a survey of the main semantic approaches that can be found in the linguistic literature. Then we turn to a description of some key data, empirical phenomena that any semantics of interrogatives has to cope with, explaining how the various approaches are motivated by them. Finally, we discuss some other empirical issues, and we end by briefly pointing out directions for future research.

Throughout, our main goal is not to give an exhaustive list of all the analyses

and variants that have been proposed over the years, but to provide the reader with an systematic argument that there is such a thing as semantics of interrogatives, and with a general characterization of its contents.[3]

Finally, the reader should be warned that the discussion that follows will not proceed in a strictly linear fashion. At certain points in the discussion of certain theories reference must be made to views that have not been treated in detail (yet). In an overview like this, where like a bird one spirals up and down, now trying to get a global view of the territory and now scrutinizing some part of it, such 'circularities' cannot be avoided.

3. The pragmatic approach

A general characterization of the pragmatic point of view, which was given above, was that it holds that the meaning of interrogative sentences in natural language can be studied fruitfully only at the level of the (speech) acts that are typically performed by uttering such sentences. This point of view can be argued for both in a more principled manner, and in a more ad hoc fashion. The principled approach springs forth from a theoretical view on natural language meaning as such. It holds that the speech act is the primary unit of semantic analysis, and that the meanings of sentences and subsentential expressions must be analyzed in terms of the part they play in such acts. Other analyses are not likewise theoretically motivated. They stay within the tradition of logical semantics (broadly conceived), but hold that at the level of semantic content no distinction between indicatives and interrogatives can, or need be made, and that hence the difference in meaning must be accounted for at another, i.e., pragmatic level.

Before turning to a detailed discussion of (one version of) the principled approach, let us briefly consider some of the forms that pragmatically oriented analyses have taken. In what follows we will not deal with the details of the various theories that have been proposed,[4] but will try to indicate what has inspired them, and what weaknesses they share. Essentially, all these analyses are what might be called 'paraphrase theories'. They analyze the meaning of interrogatives not on the level of semantics proper, but through a paraphrase of what is taken to be their typical use, i.e., by taking recourse to the level of pragmatics. In what exactly they take this paraphrase to consist, and in the way in which they implement it within a semantic framework, the various analyses distinguish themselves from each other, but this is the assumption they share: the meaning of an interrogative is given by an expression which describes its typical use.

One of the more obvious ways of implementing the paraphrase view is by making a (grammatically inspired) distinction between the *mood* of a sentence, and its *radical*. This approach has been taken by, among others, Frege [17] and Stenius [50]. The radical is the (propositional) content of the sentence, the mood the way

[3] Two excellent overviews are those of Bäuerle and Zimmermann ([2]) and Higginbotham ([33]). The overview of Harrah ([28]) deals almost exclusively with logical approaches.

[4] See the overviews referred to above.

in which this content is presented. Thus the indicative 'John is coming to the party, too.' and the interrogative 'Is John coming to the party, too?' share their radical, and differ in mood. The first sentence presents the content, viz., the proposition *that John is coming to the party, too*, in the assertive mood, whereas the same content is presented in the interrogative mood in the second example. As Frege ([17, p. 62]) puts it:

> Fragesatz und Behauptungssatz enthalten denselben Gedanken; aber der Behauptungssatz enthält noch etwas mehr, nämlich eben die Behauptung. Auch der Fragesätz enthält etwas mehr, nämlich eine Aufforderung.

The indicative mood indicates that the thought expressed[5] is asserted, i.e., is presented as true. The interrogative mood corresponds to an exhortation, viz., to affirm or to deny the truth of the thought expressed. Only sentences which express a thought can be thus analyzed. Hence, Frege claims,[6] this analysis is not applicable to what he calls 'Wortfragen', which are interrogatives such as 'Who is coming to the party?'. Such sentences Frege calls 'incomplete', presumably because they do not express a thought. Thus his reductionist approach is limited in scope. This points towards a general problem. All speech act type approaches, and in this respect the mood-radical view is similar, assume that interrogatives involve the expression of an attitude (of asking, or requesting, or not knowing, or telling) towards some kind of entity, which is what the attitude is an attitude towards. The problem is to find one kind of entity that will serve this purpose both for sentential interrogatives, and for interrogatives containing a *wh*-phrase. If one takes one's lead from the attitude, some propositional kind of entity, such as a Fregean thought, easily suggests itself. But this will do only for the first case, not for the second one.

Another line that has been explored in the literature is what might be called the 'performative approach', defended, among others, by Lewis and Cresswell (see for example [44, 12]). The meaning of an interrogative, it is claimed, is given by an explicit performative paraphrase of the illocutionary act performed. On this view the interrogative 'Is John coming to the party, too?' means the same as: 'I hereby ask you whether John is coming to the party, too.' One obvious problem with this analysis, when taken as an analysis of the meaning of interrogatives, is that it must be assumed, to avoid circularity, that the meaning of embedded interrogatives can be specified independently. This assumption seems unattractive, if not unlikely. The analysis as such has never been worked out in sufficient detail to solve this problem.

A third kind of analysis, also starting from a semantic point of view and in some respects quite akin to the performative approach, is what is often dubbed the 'epistemic-imperative' approach, mainly associated with the work of Åqvist and Hintikka (see for example [54, 35, 36]). According to Åqvist's original analysis, the meaning of our sample interrogative can be paraphrased as 'Let it be the case that I know whether John is coming to the party, too'. Hintikka opts for a similar analysis and gives the following paraphrase: 'Bring it about that I know whether John is coming to the party, too'

[5] Which in this context can be equated with the propositional content.
[6] *ibid.*

Both paraphrases display the imperative and epistemic elements involved. A remarkable feature of this variant is that it ties the meaning of interrogatives to the existence of a state of (partial) ignorance of the speaker. As a precondition on the proper use of interrogatives this might be defensible, although it implies that the use of interrogatives in circumstances where this condition is not met (such as in exam-situations) has to be explained as somehow deviant. Such an account seems possible, which is not to say that this view on such uses is necessarily correct. But by building this condition into the meaning proper of interrogatives, the present approach faces a different, and more difficult task, viz., of somehow accounting for the fact that interrogatives can be used felicitously in circumstances in which the condition is not met *without an apparent shift in meaning*.

It should be noticed, in defense of the proponents of this analysis, that their primary objective is not a systematic account of the meaning (and, perhaps, the use) of interrogative constructions as they appear in natural language. Rather, they want to develop a systematic logic of questions as abstract, logical objects (which, to be sure, is inspired by properties of natural language interrogatives). Various other aspects of the analyses of Åqvist and Hintikka bear witness to this.

For example, Hintikka analyses interrogatives in a basic two-part fashion, which is reminiscent of the mood-radical distinction, which he calls the 'request part' and the 'desideratum'. According to this scheme, the sample interrogative used above is divided into the request part 'Bring it about that' and the desideratum 'I know whether John is coming to the party, too'. Thus interrogatives share their request part (up to differences with stem from the presuppositions of the desiderata) and are differentiated according to their desideratum. The imperative operator is sensitive to the presupposition associated with an interrogative. For example, a simple constituent interrogative such as 'Who came to the party?' has as its presupposition 'Someone came to the party', and the imperative operator is restricted by the assumption that this presupposition is fulfilled. Different kinds of interrogative constructions have different presuppositions.[7]

What is interesting to note from the perspective of a semantics of natural language interrogatives is that in Hintikka's analysis embedded interrogatives take priority over stand alone interrogatives: the former occur in the paraphrase of the meaning of the latter. This seems unnatural. The problem that arises is how to supply a semantics of the paraphrase which does not presuppose an independent semantics of the embedded part. This is a general problem with the kind of paraphrase theories we are dealing with here. Hintikka tries to work his way around this problem by giving a special treatment of the epistemic operator *know* combined with a *wh*-complement. Thus, 'I know whether John is coming to the party, too' is further analyzed as 'I know that John is coming to the party, too, or I know that John is not coming to the party, too.' Thus, 'know whether' is analyzed in terms of the familiar 'know that'. Notice that this analysis does not ascribe a meaning to the embedded interrogative as such, but only provides an analysis for the combination of embedding verb and embedded interrogative.

[7] See [36], p. 174 ff.

Whether this move is descriptively adequate or not is not what is at stake here.[8] The point is rather that as an analysis of the natural language construction it goes against a strong intuition, and a major methodological principle. The intuition is that the meaning of direct interrogatives is somehow prior to, or at least not dependent on, that of sentences containing their embedded counterparts. Correspondingly, one would like to uphold, if possible, the methodological principle of compositionality, which dictates that the meaning of a compound expression be construed as a function of its component parts. That the embedded interrogative in paraphrases of the kind we encountered above, are independent parts, both syntactically and semantically, can be argued for by pointing out that they can be moved ('Whether John was coming to the party, too, was what he asked me'), can function as the antecedent of anaphoric expressions ('Mary still wondered whether John was coming to the party, too, but Bill knew it'), and so on. Thus, it seems that, at least from the perspective of natural language, one would prefer an analysis which treats embedded interrogatives as distinct parts of the construction in which they occur. But then paraphrase theories run into a serious difficulty. For it seems most natural to treat the independent meaning assigned to an embedded interrogative on a par with that of its stand-alone counterpart, which makes the paraphrase treatment of the latter patently circular. For better or worse, it seems that on the basis of fairly general considerations, one is forced to abandon the paraphrase approach, and to treat the meaning of interrogatives as *sui generis*.[9]

This summary indication of the various forms that paraphrase analyses may take, shows that they are not without problems. Trying to elucidate the semantics of interrogatives, these analyses resort to what are essentially paraphrases of the pragmatics of these constructions, i.e., of the way in which they are typically used. But in doing so, the problem of specifying an independent semantic content of interrogatives can not be avoided altogether, it seems. In view of this, one might well think that perhaps a more principled approach, which starts from the assumption that meaning as such has to be defined in terms of use, might fare better. Therefore, we will concentrate in the remainder of this section on the more principled approach. The main objections to the latter also apply to the former, as will be pointed out along the way. As we will argue, the pragmatic point of view, although certainly not without an intuitive appeal, is not able to account for some simple, but basic facts. This in itself provides ample reason to reject the pragmatic approach as such, and to investigate whether taking a truly semantically oriented point of view will enable one to do better in this respect.

[8] One obvious problem is with such embedding verbs as *wonder*, which do not admit of a straightforward paraphrase along these lines.

[9] This point was argued for forcefully by Nuel Belnap jr, in the form of his celebrated 'independent meaning thesis'. See [3].

3.1. Starting points

Speech act theory, as it was developed systematically in the pioneering work of Searle in the late sixties, which in its turn depended heavily on Austin's work on performativity, provides a more principled approach than the ones discussed above. It starts 'from the other end', as it were, and regards the act performed by the utterance of a sentence as the primary unit of semantic analysis. Combined with the observation that assertion is but one among the many acts that can be performed through the use of language, this view radically opposes the 'propositional bias' supposedly inherent in traditional logical analysis.

Interrogatives as such have been given due attention in Searle's original work ([48]), but the concrete analyses he provides there do not really extend the coverage of the proposals discussed above. The main advantage of Searle's analysis seems to lie in this that it is carried out in a systematic framework, which takes the pragmatic point of view as its starting point in the analysis of natural language as such. As said, its empirical coverage remains rather limited, and it does not contain a principled discussion of how it relates to other types of analyses of interrogatives.

It is in these two respects that the work of Vanderveeken (see [52]) constitutes an important step forward in the development of a pragmatic analysis of interrogatives. Especially through its discussion of logical and semantical theories, Vanderveeken's work provides a much more detailed picture of what a speech act analysis of interrogatives amounts to. Also it poses some interesting challenges for semantic theories, which will be important for a proper assessment of the latter. For these reasons we will discuss Vanderveeken's work in some detail.

3.2. General framework

Vanderveeken formulates a general semantic framework, which he views as a conservative extension of Montague's universal grammar. His aim is not to develop speech act theory as a rival of truth-conditional semantics, but to provide 'a systematic unified account of both the truth conditional and the success conditional aspects of sentence meaning' ([52], vol. i, p. 11). However, in this general framework the speech act point of view prevails: 'My fundamental hypothesis is that complete illocutionary acts [...] are the primary units of literal meaning in the use and comprehension of natural languages' (*ibid.*). The system of illocutionary logic that Vanderveeken aims to develop, characterizes the space of possible illocutionary acts.[10] This 'transcendental' (vol. i, pp. 55–56) tool, also called 'general semantics', can then be applied in the description of sentence meaning in natural languages. That truth conditional semantics alone will not suffice, Vanderveeken argues by pointing out that, e.g., 'John will do it.', 'Please, John, do it!' and 'If only John would do it.', express the same proposition with respect to some con-

[10] Vanderveeken uses Austin's term 'illocutionary act' in distinction to the term 'speech act', which covers more ground (see below). According to Austin's original formulation an illocutionary act is 'an act [performed] *in* saying something' ([1], p. 99).

text of utterance, but are used to perform different illocutionary acts with different forces. The illocutionary component, Vanderveeken concludes, is an integral part of linguistic meaning. Not all languages relate to the space of possible illocutionary acts in the same way. Linguistic analysis will reveal a variety of relationships that exist between the types of sentences and other expressions that a given language displays and the kinds of illocutionary acts that are typically performed by (literal) utterances of them.

The characterization of the realm of possible illocutionary acts proceeds recursively. Elementary illocutionary acts are of the form $F(P)$ and consist of an illocutionary force F and a propositional content P. Besides elementary illocutionary acts, Vanderveeken acknowledges also complex ones, such as conditional illocutionary acts, illocutionary negation, etc.[11] These complex illocutionary acts can not be reduced to elementary ones. Complex speech acts are built using illocutionary connectives, and by means of certain performative verbs. The details of this aspect of Vanderveeken's illocutionary logic need not concern us here, so we will refrain from further discussing it.

What *is* relevant is the distinction between *success conditions* and *satisfaction conditions*. The first type of condition determines whether a speaker through an utterance of a sentence has indeed succeeded to perform the corresponding illocutionary act. For example, certain conditions must be fulfilled for a speaker to have made a request by uttering 'Please, pass me the salt.' Success conditions are determined by the illocutionary force F of an illocutionary act. Satisfaction conditions depend on its propositional content P. Thus, in the above example the satisfaction conditions specify that the request is satisfied if the hearer has realized the situation characterized by the propositional content, viz., that the hearer passes the salt. In this example the satisfaction condition has what is called a 'world-to-word' direction of fit: in order for the satisfaction condition to be fulfilled the world has to fit the words. The other direction, the 'word-to-world' fit, is characteristic for the satisfaction condition of assertions: for an assertive illocutionary act to be satisfied its propositional content should match an existing state affairs, i.e., it should be true.

An interesting problem arises when we consider the satisfaction conditions of interrogative illocutionary acts. Vanderveeken classifies such acts as *directive* speech acts, along with requests (vol. ii, p. 11). That implies that the satisfaction condition of an interrogative act has the world-to-word direction of fit: it requires the hearer to make true the propositional content of the interrogative. The question then rises what this propositional content is. We will come back to this later on.

3.3. Criticisms of the semantic approach

After this very summary sketch of the aims of Vanderveeken's enterprise, let us now turn to the more concrete issue of the critical remarks he makes on more traditional

[11] See vol. i, pp. 24–25, for further details.

semantic approaches. Here a distinction can be made between logically oriented approaches, which aim at the development of a pure logic of questions, without paying attention to the relationship with natural language, and more linguistically oriented work, for example within the framework of an (extended) Montague grammar. According to Vanderveeken both lines of investigation share a common methodology, which is largely due to Belnap:[12] all analyses 'tend to identify a *question* with a set (or a property) of possible *answers* to that question' (vol. ii, p. 9). Moreover, the various analyses also 'tend to identify answers with propositions or other senses' (*ibid.*). Vanderveeken refers to this as a theoretical *reduction* of questions to senses, and distinguishes the following principles on which such a reduction is based:

(i) To understand a question is to understand what counts as an answer to that question

(ii) An answer to a question is an assertion or a statement

(iii) An assertion is identical with its propositional content

Of course, he notes, these principles leave considerable lee-way for actual analyses: e.g., Hamblin ([27]) identifies a question with the set of propositional contents of its possible answers, whereas for Karttunen ([40]) it is the smaller set of its true answers. And in some other variants, e.g., Hausser's ([29]) answers are identified with the senses of noun phrases rather than those of sentences.

Vanderveeken's main objection is that this type of approach is *reductionistic*: questions are not treated as constituting a category in their own right, but are reduced to other types of entities, viz., propositions. Thus, this methodology does not take illocutionary force into account, or, rather, it reduces illocutionary force to sense. And this is incompatible with the main motivation of speech act theory. Accordingly, Vanderveeken argues that the three principles mentioned above are incompatible with basic facts of language use.

However, it is not that obvious that (all of) the theories Vanderveeken mentions aim at a reduction of illocutionary force to sense. (And even if they pretend to do so, it remains to be seen whether they really have to be taken that way, i.e., whether the results they obtain really depend on this avowed starting point.) Rather, it seems that the primary aim of theories in this tradition is to characterize a notion of (cognitive) content for interrogative language use, c.q., for interrogative sentences. And the underlying assumption seems to be that one can do so without subscribing to a reductionist methodology, i.e., without claiming that once the contents of interrogatives have been characterized an illocutionary analysis of their function is superfluous. For can one not do truth conditional semantics for assertive language, without claiming that this makes a speech act analysis superfluous?

This is not to say that Vanderveeken's characterization of the theories in this tradition is completely off the mark. Indeed, (some version of) the first of the three principles Vanderveeken distinguishes seems to be subscribed to, be it sometimes only implicitly, by most protagonists of erotetic logic. The basic semantic intuition underlying this is the following. To understand an indicative sentence, i.e., to grasp the contents of an assertive act, is to know under what conditions it is

[12] According to Vanderveeken. But cf. the Hamblin postulates, discussed in section 4.1.

true. Similarly, to understand an interrogative sentence, i.e., to grasp the contents of an interrogative act, is to know under what conditions it is answered. As indicatives are associated with truth conditions, interrogatives are linked to answerhood conditions. But it should be noted at the outset that this leaves very much undetermined: although the association of answers with propositions is an obvious one, it is by no means necessary. Answers can be given in many different ways, even if we consider only linguistic means to do so. Exclamations, subsentential expressions such as noun phrases ('Who did you meet there?' 'Some linguists.') or prepositional phrases ('How did you get here?' 'By train.'), but also non-indicative sentences ('Did you really hear him say that?' 'Would I lie to you?') may be used to answer interrogatives. So, although indeed some analyses concentrate on answers expressed by indicative sentences, this restriction does not follow from the basic intuition described above.

Hence, Vanderveeken's second and third principles are not necessarily subscribed to by an erotetic logician who adheres to the first one. Nevertheless, what would make one think so? There is a chain of associations at work here. Clearly, whatever linguistic (or non-linguistic) form they have, answers convey information, in a broad sense. An interrogative act is a request to tell the hearer something (not necessarily something he does not already know). And, by definition, an answer is something that does that, i.e., something that conveys information which is pertinent to the request. From a semantic perspective, propositions are the natural 'units of information'.[13] Of course, the concept of a proposition is a theoretical one: unlike linguistic expressions, or speech acts, propositions are not observable entities. Thus, the assumption of their existence has to be licensed in some other way, e.g., by reference to their usefulness in descriptive and explanatory contexts. One of these is the speech act analysis of assertive acts, or the semantic analysis of indicative sentences. Here, it is commonly assumed that what an assertive act conveys, or what an indicative sentence means, is a proposition. But notice that it is only when we *define* the notion of a proposition in such a way, i.e., as that what is expressed by an assertion, that Vanderveeken's second and third principle make sense. But obviously, no such conception is forced upon us by adherence to the first principle. A simple observation makes clear that we had better refrain from this identification of propositions with contents of assertions, or indicative sentences: in the examples given above the function of the various linguistic expressions in the context of the preceding interrogatives can very well be described as that of 'conveying a proposition'.

In view of the above, it seems that Vanderveeken's charge of 'reductionism' is unwarranted, at least in this sense that the idea that interrogatives be analyzed in terms of answers, or answerhood conditions, in itself does not lead to a reduction of interrogatives to assertions. There seems to be room for a perspective on the meaning of interrogatives according to which a consistent and useful distinction can be made between an analysis of their contents, at the level of semantics, and

[13] Which does not mean that the concept is used uniformly. Various divergent analyses exist, but they all share the idea of a proposition as a unit of information.

one of the interrogative acts typically performed by the use of them, at the level of pragmatics. The semantic analysis is carried out in terms of answers, but these should be taken to be the contents of whatever linguistic expressions that can be used to answer questions, which are not tied exclusively to assertions as a separate kind of speech act.[14]

Another claim that Vanderveeken makes in the context of his charge of reductionism is interesting to consider, for it, too, seems to rest on a misapprehension if not of concrete analyses, then at least of the potential thereof. What Vanderveeken suggests is that erotetic logicians in their reductionist' enthusiasm identify questions with (sets of) propositions, viz., the propositions expressed by (true) answers. But this is only true in a certain sense, and only for some of them. In this context it is important to keep track of the distinction between sense and denotation. For ordinary indicative sentences, those which are normally used to make assertions, the standard analysis identifies their sense with a proposition, and their denotation in a particular world or context with a truth value. The reductionist principles that Vanderveeken ascribes to semantic analyses might suggest that interrogatives receive the same kind of propositional sense, and hence, contrary to the most basic intuitions, would denote truth values. But as we saw above, the sense of an interrogative is identified with answerhood conditions, not truth conditions. To the extent that these answerhood conditions are explicated in terms of propositions, the denotation of an interrogative in a particular world or context would not be a truth value, but rather a proposition (or a set thereof), viz., the proposition(s) that in that context would be expressed by a true answer. And, its denotation being of such a propositional nature, the sense of an interrogative, conceived of in the usual way as a function from contexts to denotations, would be a propositional concept, rather than a proposition.

In view of this observation it is clear that Vanderveeken's charge of reductionism is misdirected, also for analyses which do make use of propositions: such analyses do not reduce the contents of interrogatives to that of indicatives. The contents ascribed to both are different, and the differences correspond to the difference between truth conditions and answerhood conditions. Here the pragmatic distinction between the kinds of speech acts typically performed by the use of interrogatives and indicatives is reflected in the type of their semantic contents, as is to be expected. By no means should the acknowledgement of a distinct kind of semantic object to serve as the contents of interrogative sentences be taken as an implicit argument that a speech act analysis of interrogative acts is no longer needed. But it does amount to the claim that, speech act theory or no speech act theory, interrogatives are distinguished not only through their illocutionary force, but also through their contents, which is related to, but distinct from the contents of assertions. What needs to be noted is that this claim, at least at first sight, seems at odds with the central thesis of speech act theory that all (elementary) illocutionary acts are of the form $F(P)$, where F is the illocutionary force, connected with

[14] Needless to say that a speech act analysis of interrogative acts according to which they can be (should be) reduced to assertive acts, stands in need of justification, too.

conditions of success, and P is the propositional content, to be explicated in terms of satisfaction conditions. Semantic analyses of the kind outlined above would lead one to conclude that interrogative illocutionary acts do not have a proposition as their content, but rather some kind of propositional concept, to which the notion of satisfaction does not seem to apply. We return to this point below.

We conclude that Vanderveeken's main criticism, that semantic analyses which analyze the contents of interrogatives in terms of answers are reductionist in nature, is unfounded.[15] However, the perspective of speech act analysis leads him to formulate some other points, which constitute interesting challenges for an overall theory. One thing Vanderveeken notes is that full sentential linguistic answers to interrogatives are not necessarily assertions (p. 10). For example, the interrogative 'Do you confirm his nomination?', can be answered by a so-called declaration: 'Yes, I hereby confirm it'. And similar things can happen in case of such interrogatives as 'Do you promise to come?', which can typically be answered with a performative 'Yes, I promise to be there'. An approach which analyzes interrogatives in terms of answers, ànd which identifies answers with assertions is in trouble here. But as we pointed out above, the latter move is not necessary. Still, it remains to be seen in what way a semantic analysis of interrogatives in terms of answers will be able to cope with examples such as these. For it seems that such approaches *are* wedded to the idea that answers provide information. That is, they seem to presuppose that answers, whatever illocutionary act is performed by the use of them, have propositional content. To what extent such examples as cited above fit this scheme is not obvious. The performative sentences provide information, but not in the sense intended. One way to account for this is to uphold that this is in fact due to the interrogatives. For example, one might say that such an interrogative as 'Do you promise to come?' does not request the hearer to provide information, but asks for a promise. (Cf., the contrasting 'Did you promise to come?') Or consider the interrogative 'What shall we have for dinner tonight?'. This interrogative is typically used to elicit some discussion or suggestions about what to eat tonight. (Cf. the contrasting 'What are we having for dinner tonight?') In view of such examples it may make sense to distinguish informative from non-informative interrogatives. The latter primarily do not ask to provide information, but to perform some other action, even though either a positive or a negative answer will also provide the information that the action will, or will not, be performed. The challenge to semantical theories of the kind outlined above now is to come to grips with this phenomenon. One move might be simply to restrict the application of the theory to informative interrogatives. But this seems unsatisfactory. Another position one could take is to generalize and say that what all interrogatives have in common is that they present some potential alternatives. In the case of informative interrogatives these are alternative ways the world is like, in the case of non-informative ones such as those mentioned above, the alternatives concern actions of the hearer.

[15] To be sure, we refer here to what such analyses in principle are forced to acknowledge. This does not mean that there may not be proponents of this approach which *do* have reductionist aims.

Another point that Vanderveeken raises and that constitutes a challenge for any theory is the following. Interrogative acts are just one type of illocutionary acts embedded in a whole field of linguistic acts which are interrelated in various ways. Hence, a logic of questions can not be an isolated affair, but should be integrated within a general logic of illocutionary acts. An exposition of how Vanderveeken wants to realize this, would take us to far afield. Suffice it to notice that, as is not unusual, Vanderveeken takes the use of an interrogative sentence to constitute a kind of request, the contents of which he describes as follows: 'A speaker who asks a question requests the hearer to make a future speech act which is a (non-defective or true) answer to that question' (vol. ii, p. 11). Requests are considered to be a subclass of directives, which are a basic type of illocutionary act. In this way, Vanderveeken wants to account for the systematic relationships that exists between interrogative acts and other illocutionary acts. The challenge for a semantic theory is, of course, *not* to provide such an account itself, but rather to lend itself to it. Granting that there is such a thing as a logic of illocutionary acts, in which interrogatives are to be treated as a kind of requests, a semantic analysis of the contents of interrogative sentences must be such that it can be embedded in such a logic. But, of course, this demand does not exclude the existence of a logic of questions, not as acts of requesting, but as the particular kind of semantic objects that constitute the cognitive contents of interrogative sentences.

And we may even take a stronger position with regard to the relationship between the two. Vanderveeken recognizes that a logic and semantics of the contents of assertive language use is important, and is part of a richer illocutionary logic. Would not the same hold for the logic and semantics of the contents of interrogative language use? One argument for that would be that an illocutionary analysis of interrogatives will need to appeal to questions as the contents of interrogatives, i.e., that a logic of questions is needed as a preliminary for a pragmatic analysis. That this is indeed the case may in fact be argued on the basis of the illocutionary paraphrase that Vanderveeken and others give of interrogative acts.

3.4. Questions as requests

What does Vanderveeken analysis of interrogative acts amount to? As we saw above, the illocutionary force of an interrogative act is that of a request of the speaker to the hearer. The propositional content is special: the request is that the hearer perform a future speech act which is a correct answer to his question. Thus, an explicit performative paraphrase would be something like the following: 'I (hereby) ask you to answer (the question) Q', where Q is some specific interrogative. Paraphrasing in terms of an explicit directive of the request type we would get something like: 'Please, tell me Q', with Q the same as above.

What needs to be noticed is that in such paraphrases interrogatives again appear, not as illocutionary acts, but as entities which characterize the contents thereof. Thus, it would seem that a specification of the propositional contents of interrogative acts can not get around acknowledging the existence of questions as semantic

objects, given that, as Vanderveeken recognizes, the content of a whole is determined by the contents of its parts.

This conclusion runs contrary to Vanderveeken's intentions. It is no coincidence, perhaps, that the one particular example that is provided (vol. ii, p. 158) concerns a simple sentential interrogative: 'Is it raining?'. In such examples, it is indeed possible to avoid reference to anything like questions as semantic objects. Informally, the analysis amounts to the following: 'I request that you assert that it rains or deny that it rains.' This does indeed seem to avoid the introduction of questions. But it is not quite obvious that Vanderveeken's treatment is correct as far as it goes, nor that it can be generalized. As for the first, asking a question is not simply a request to the hearer to make one of two assertions *at his or her liberty*. What we want is not merely some claim, but the truth: we want to know whether it is raining, not merely to be told that it is, or that it is not. Thus, a more adequate paraphrase along Vanderveeken's lines would be: 'I request that if it rains, you assert that it rains, and if it does not rain, you deny that it rains.' Granting that this modified paraphrase is more correct, it is still not so easy to see how this strategy of reducing questions away, can be applied generally. There seem to be different kinds of interrogatives, and different kinds of contexts in which they occur, that defy this analysis. To start with the latter, the modified paraphrase is adequate for certain contexts, such as *request*, *know*, *tell*, and the like. But as a paraphrase for interrogatives embedded under such verbs as *wonder*, or *investigate*, the result is clearly incorrect. And moreover, not all direct interrogatives seem to bend to the reduction as easily as simple sentential interrogatives. Consider a simple constituent interrogative such as 'Which students have passed the test?'. The following paraphrase suggests itself: 'I request that for each student that if (s)he passed the test you assert that (s)he passed the test, and if (s)he did not pass the test, you deny that (s)he passed the test.' But this will not quite do. For the proposition we want to be asserted should claim of the person who passed that (s)he is a student, which is something this analysis leaves out of consideration. And notice that a more straightforward paraphrase, such as 'I request you to tell me which students passed the test', where the question occurs in the content explicitly, potentially avoids this problem, since it allows us to build this into the content itself. Thus it seems that Vanderveeken's strategy of avoiding an appeal to questions as contents of interrogatives in his analysis of the meaning of stand alone interrogatives fails. Acknowledgement of this type of semantic objects simply can not be avoided.

And of course there is no principled reason for Vanderveeken to want to avoid questions as contents to play a role in determining the propositions that present the contents of speech acts, be it asking a question or otherwise. Their existence constitutes no threat whatsoever against his general enterprise, and actually might make things easier. Embedded interrogatives play a part in many types of sentences, also simple declarative ones. In such contexts, it seems far from obvious that a speech act type of analysis is what is called for.

The above considerations suggest that the pragmatic approach, whatever its inherent virtues as an analysis of the use of interrogatives, i.e., of interrogative acts, will not do as an account of the meaning of interrogative sentences, given that we

want such an account to satisfy certain requirements. For example, it seems desirable that interrogatives be treated as independent parts of sentences and that related meanings be assigned to stand alone and embedded interrogatives. But also when taken as an analysis of interrogative acts, the pragmatic approach as worked out by Vanderveeken faces some difficulties which are worth pointing out.

3.5. Asking a question as a basic speech act

The above considerations criticize the pragmatic approach 'from the outside' as it were. In this section we take up an issue that constitutes an internal criticism of the analysis put forward by Vanderveeken. One remarkable aspect of his analysis is that in Vanderveeken's typology asking a question is not a basic speech act. It belongs to the basic type of *directives*. The illocutionary point of a directive is making an attempt to get the hearer to do something (vol. i, p. 105). Like commissives, directives have the 'world-to-words' direction of fit: their point is to make the world fit the words. The world is to be transformed by some future act, of the hearer in the case of a directive, of the speaker in the case of a commissive, in order to match (satisfy) the propositional content of the speech act. The transforming act is specified by the propositional content of the speech act. And the success of the speech act depends on the world coming to satisfy this content.

According to Vanderveeken, asking a question is a special kind of directive. It is a request, which means that unlike other directives, it allows for the option of refusal. Furthermore, it has a specific kind of content: it asks for some future speech act of the hearer which gives the speaker a correct answer to her question. Notice that the 'intuitive' notion of question-as-content appears here, too, not as the (propositional) content of the act of asking a question, but embedded, as the paraphrase given just above suggests. (Note that one cannot replace 'question' again by 'request etc.', on pain of getting into an infinite regress.)

The peculiar thing to note is that the world-to-words fit that is the illocutionary point of an interrogative act, seems to be of a different kind than that of a simple request, such as 'Please, open the door for me.' The latter calls for an action that transforms the world as such, whereas asking an informative question, such as 'Will Mary come tonight?', does not. What it demands is that a change be brought about in the information state of the speaker, an effect that can typically be achieved by the performance of a speech act of assertion or denial with the appropriate content. Of course, any utterance transforms the world in this, admittedly rather trivial, sense that after the act has been been performed it has been performed. But for these kinds of speech acts that is not the real point: they require a change in information about the world, not in the world itself.

Of course, in a certain sense, the information a speech participant has about the world, and about the information of other speech participants, also forms part of the world, but it does so only in a secondary, derivative sense. The world and the information one may have about it, are clearly to be distinguished. The following consideration may perhaps clarify why. One can imagine languages that only express

things about the world, *sensu strictu*, and not about information, nor about speech acts. Nevertheless, such a language may very well contain assertives, directives, maybe even commissives, and interrogatives. And it seems that the meaning of such sentences can be stated without any overt or covert reference to information as such. In other words, the ontology of both the object and the meta-language may be stated without reference to anything but objects constructed with set-theoretical means from things in the world itself.[16]

This is a strong indication that, systematically, these levels, of the world and of information about it, are to be kept apart. Moreover, it shows that the 'merge' between denotational and pragmatic aspects of meaning that speech act theory presupposes, is not forced upon us, at the very least, and that it may even be wise to distinguish the two as much as possible. In section 4 two examples are discussed that corroborate this point.

Now to return to Vanderveeken's typology, it seems that from the perspective adopted above, there is no reason to classify interrogative acts as a subtype of directives. Assuming with Vanderveeken that the latter call for an action of the hearer to change the world, their contents can indeed be identified with the specific change in the world required.[17] But assuming that interrogative acts call for an act of conveying information, and adopting the perspective that distinguishes between information and what information is about, interrogatives simply are not of the same type as directives, but rather must be regarded as constituting a basic type of speech act in their own right.[18] And one might even go further and argue that interrogative acts do not necessarily direct the hearer towards any kind of action, except perhaps that of considering the question. To ask a question and to ask someone to answer a question do not necessarily seem to be the same thing. On this view, the content of an interrogative act need not be propositional at all.

Thus it seems that we must conclude that Vanderveeken's typology overgeneralizes, and does not fully do justice to the own nature of interrogatives as a separate kind of speech act.[19]

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[16] Information states in dynamic semantics, e.g., are of this nature.

[17] Of course, although primarily concerned with changing the world, directives also involve a change in information. The information they convey is that the speaker wants the hearer to change the world in a certain way. And the accommodation of this piece of information, i.e., the actual change in the information state of the hearer this brings about, may even be important in bringing about what the speaker wants. For example, an explicit recognition of a certain wish that the speaker entertains on part of the hearer, may be what drives him to try and bring about the desired transformation in the world. But the important point is that this change of information does not constitute the primary point of a directive, which is directed at the world, and not at the information the hearer has about the wishes and needs of the speaker.

[18] Notice that the Åqvist/Hintikka approach explicitly recognizes that to bring about a change in the information state of the speaker is what is being requested of the hearer.

[19] Which is remarkable, in a certain sense. For did not the pragmatic approach claim to be heir to Wittgenstein's later work? But as the latter wrote (*Philosophical Investigations* § 14):

> Denke dir, jemand sagte: "*Alle* Werkzeuge dienen dazu, etwas zu modifizieren." [...] Wäre mit dieser Assimilation des Ausdrucks etwas gewonnen?

In this case not, it seems.

3.6. Summing up sofar

Let us take stock. In the above we have distinguished two major streams in the theory of interrogatives. One, which we dubbed the 'pragmatic approach', analyzes interrogatives at the level of speech acts. Major proponents of this approach, in one variant or other, are Åqvist, Hintikka, Searle, Vanderveeken. Within the other approach interrogatives are analyzed at the level of semantic content, i.e., interrogatives are viewed as a particular type of expressions, with a particular type of sense and denotation. The work of Belnap, Hamblin, Karttunen, Higginbotham and May, and Groenendijk and Stokhof exemplifies this trend.

Besides these a third position can be distinguished, which is a real reductionist one. It identifies interrogatives with statements, for example in Lewis' explicit performative hypothesis ([44]). Another example is provided by the work of Tichy ([51]). Here there is neither recourse to speech act theory, nor to any special type of semantic content. Plain truth conditional semantics, it is claimed, is all we need.

The argument against the third view is clear. The performative analysis is circular if not combined with an independent analysis of the meaning of embedded interrogatives. And Tichy's analysis, according to which there is no semantic distinction between interrogatives and indicatives, and which therefore must take recourse to a 'difference in pragmatic attitude of the speaker' ([51, p. 276]) in order to keep them apart, simply fails to account for what are obvious semantic differences, such as exemplified by sentences in which interrogatives are embedded. Consider 'John knows that Bill walks' and 'John knows whether Bill walks'. If the embedded interrogative and the embedded indicative really have the same semantic value, then each of these sentences should have the same value, too. If Bill walks, and John knows this, we might say that that is indeed the case: both are true. But if Bill does not walk, and John knows this, then they differ in value: in that case the first sentence is false, whereas the second is true.

Such a simple example suffices to show that there are semantic differences between interrogatives and indicatives, and that the semantic content of interrogatives needs to be accounted for.

As said, the pragmatic approach, unlike this reductionist view, tries to do so, although it does not regard the semantic content of interrogatives as a kind of semantic entity of its own. But it encounters difficulties of its own, as we have seen. Does this mean that the pragmatic approach is wrong, and that hence only a semantic analysis can be pursued? Not necessarily. It is of some importance to notice that a priori there is no clash between the two. The case of indicatives may serve to illustrate this.

It seems that most people would agree that one can make a fruitful study of important aspects of the propositional content of assertive language use, without taking into account aspects of illocutionary force. In other words there are systematic aspects of the meaning of indicatives which can be studied independently of their use. Of course, such a semantic account will be limited, it will not cover all aspects of meaning in the intuitive sense, since some of these *are* intrinsically connected with the speech acts which are characteristically performed with indicative

sentences. But granting that, most people would grant as well that there is such a thing as a 'pure semantics' of indicatives.

This point is even reinforced if we consider the pragmatic approach. For according to Vanderveeken every illocutionary act is of the form $F(P)$, i.e., it has a propositional content, and nothing seems to exclude a restricted, but independent theory of propositional content as part of his overall scheme.[20]

As the discussion above has shown, there seem to be no principled reasons for not viewing the meaning of interrogatives in the same way. They, too, have a semantic content (propositional or otherwise), which, it seems, can be studied systematically and fruitfully independent of a study of their characteristic illocutionary uses. Again, such a semantic analysis would only be part of the whole story, but a necessary, and not altogether unimportant or uninteresting one.

So it seems that no a priori considerations would prevent one from taking up the position that both approaches, the pragmatic and the semantic one, are justified in their own right, if put in the proper perspective. An overall theory of meaning has to deal with both cognitive content and illocutionary force, as two aspects of meaning. At least to some extent, it seems, both can be studied independently. When applied to interrogatives this means that one may hold that questions do constitute a separate semantic category, distinct from that of propositions. The latter being the cognitive content of assertive language (use), the former are the contents of interrogative language use. And one can even push this a little bit further, and argue that in a speech act theory, which deals with both content and illocutionary force, the special content of interrogative language use has to be taken into account.

This may suggest a more or less traditional division of labour between semantics and pragmatics. However, it must be borne in mind that where the borderline between the two is actually drawn may change over time. For example, until recently one would, with respect to assertives anyway, make a neat distinction between truth-conditional aspects of meaning, constituting the domain of semantics, and illocutionary aspects, including conversational implicatures and the like, which were supposed to be handled in pragmatics. The development of theories of dynamic semantics has changed this picture. On empirical and theoretical grounds various people have argued that not truth, but information change potential is the core notion of semantics, thereby significantly extending its coverage. So what exactly constitutes a semantics of interrogatives is a different question than whether there is such a thing in the first place.

We take it that by now we have made it at least plausible that the latter question must be answered affirmatively. We will therefore turn in the next section to some considerations concerning the character and contents of a semantics of interrogatives

[20] Caveat: there are sentences, such as explicit performatives, of which it seems reasonable to assume that their content can be dealt with only if both aspects of meaning are taken into account at the same time.

4. The semantic approach

Above we have argued that the interpretation of interrogatives in terms of the success and satisfaction conditions of performing the illocutionary act of asking a question presupposes the notion of a question as a distinct type of semantic object. In order to be able to analyze what it is to ask a question, and what counts as an answer, we have to establish what questions are. In this section we will discuss some fundamental principles which have guided much of the research into the semantics of questions over the past two decades, and we will show that they guide us towards a relatively simple, but explanatory powerful picture of what kind of semantic objects questions are. The various concrete analyses that have been put forward in the literature can be characterized in terms of variations on this one common theme. We will also discuss some criteria of adequacy which, be it often implicitly, have been used to evaluate various proposals and direct further research. The resulting picture does have its limits, however. We will discuss some of these, and point out in which way one might try to overcome them.

4.1. 'Hamblin's picture'

The general picture of questions as semantic objects that we are about to sketch we call 'Hamblin's picture', because we derive it from three general principles which Hamblin was the first to formulate (in [26]). The quotes, however, are (also) scare quotes: we do not claim that Hamblin actually would agree with the outcome. In fact, his own analysis in [27] does not (quite) conform to it.

The principles in question were already referred to above, when we were discussing Vanderveeken's objections to what he considers the methodology of reducing questions to answers. Hamblin's postulates read as follows:

(i) An answer to a question is a sentence, or statement.

(ii) The possible answers to a question form an exhaustive set of mutually exclusive possibilities.

(iii) To know the meaning of a question is to know what counts as an answer to that question.

In what follows we will discuss these three principles separately. In doing so, we are *not* after a reconstruction of Hamblin's intentions (recall the scare quotes), but rather want to investigate the systematic impact of the principles as such.

The main impact of Hamblin's first postulate is to turn attention away from 'surface' syntactic form. On the linguistic surface, answers often appear as subsentential phrases: for example as NPs ('Who came early?' 'John.'), PPs ('Where are you going? 'To Amherst.'), VPs ('What do you want to do?' 'Have fun.'), and so on. However, the first postulate emphasizes that the function of answers, whether subsentential or sentential, or even when provided by non-linguistic means, is to provide information, and hence that their semantic status is that of a proposition.[21]

[21] This postulate is reflected in early systems of erotetic logic in the identification of interrogatives with sets of *formulae*. To provide an answer to an interrogative is then to choose the true ele-

The second postulate specifies the nature of the propositions that count as answers to a question. One thing it says is that the propositions that count as answers to a question logically exclude one another: the truth of each of the answers implies the falsity of the others. This means that individual answers are regarded as 'exhaustive' in the sense that each answer, if true, provides completely and precisely the information the question asks for. Furthermore, the postulate states that the set of answers is also exhaustive in the sense that the union (disjunction) of its members completely fills the logical space defined by the question. In other words, no possible answers defined by the question are left out.

The logical space defined by a question is the space of possibilities it leaves for the world to be like. It can either be taken to be the entire logical space, or that part of it in which the presuppositions of the question are fulfilled. If in a particular situation the presuppositions of a question are not fulfilled, then, one might reason, it has no answer in that situation. In such a case, the only appropriate reply would be to express the proposition that denies that the presupposition is fulfilled.

The picture that emerges from these two postulates, is that the possible answers to a question form a *partition* of the logical space. Taking presuppositions into account, one part of the partition has a special status, being marked as that part of logical space in which the presuppositions of the question do not hold. (Alternatively, on a non-presuppositional approach, the proposition that expresses that the presuppositions do not hold is counted as one of the answers.)

An immediate consequence of the exhaustive and mutually exclusive nature of the set of possible answers is the following: in each situation (in which its presuppositions are fulfilled) a question has a unique complete and precise true answer, viz., the unique proposition among the possible answers that is true in that situation.[22] This is not to say that this feature cannot be challenged. However, if one thinks that there are reasons to give it up, one must be willing to modify at least one of the two postulates from which it follows.

It may be worthwhile to stress at this point that the notion of answerhood that is under discussion here does not refer to linguistic objects, but to semantic objects: propositions. The existence of a unique true, complete and precise semantic answer does not imply that it can be expressed by linguistic (or other) means, nor that if it can be expressed, it can be expressed in a unique way. Also, even in case we are unable to express a semantically complete and precise answer, circumstantial pragmatic factors may still make it possible to actually convey such an answer. Likewise, pragmatic factors may determine that under different circumstances, depending, e.g., on common knowledge among questioner and questionee, different

ment(s) from the corresponding set. This syntactic set-up relates directly to the primary goal of such systems, which is not primarily the description of the semantics of interrogatives in natural language, but rather the development of formal tools, which can be put to a variety of uses, for example to query databases. (Cf., e.g., Belnap & Steel: 'our primary aim here is rather to design a good formal notation for questions and answers and a good set of concepts for talking about them' [5], p. 2.) But here we are after a proper semantic notion, i.e., one that can be stated in terms of semantic objects, to serve as the interpretation of expressions of natural language.

[22] Assuming that the question has a true answer.

propositions are most effective in actually conveying precisely the information the question asks for. In short, the everyday observation that one and the same question can often be answered in many different ways, is not necessarily at odds with the existence of a unique true and complete semantic answer.

The importance of the third postulate, finally, is that it identifies the meaning of an interrogative with the partition of logical space which is constituted by the set of its possible answers. That is to say, questions, as semantic objects, are taken to be partitions of logical space. Notice that, Vanderveeken's qualms (see above, p. 11) notwithstanding, the charge of reductionism is not justified: the meaning of an interrogative is a separate kind of entity, it is not *reduced* to the meanings of expressions which serve as answers, viz., to propositions. Of course, the two kinds of semantic objects are related: the elements of a partition are propositions. In this respect, the case of interrogatives is quite comparable to that of indicatives. Knowing the meaning of an indicative, i.e., knowing under which circumstances it would be true, obviously does not imply knowing whether it is true. Likewise, knowing the meaning of an interrogative, i.e., knowing what would count as the true answer in which situation, does not include knowing what its true answer is.

The picture that emerges from Hamblin's three postulates is extremely elegant, and (hence?) (onto-)logically compelling. But at the same time there are at least two reasons to doubt its correctness. The first one is that the picture presupposes that every question (with non-contradictory presuppositions) has an answer. This we call the 'Existence Assumption'. But, one may ask, is this assumption justified? Are there not unanswerable questions?[23]

The second objection that can be raised, is that the picture presupposes that every interrogative has precisely one true (and complete) answer in a situation (in which its presuppositions are fulfilled). This we may dub the 'Uniqueness Assumption'.[24] Are there not interrogatives with several alternative equally true and complete (equally satisfactory) answers which are not logically equivalent? Potential candidates are so-called 'mention-some' readings ('Where can I buy an Italian newspaper?') and 'choice' readings ('What do two of these computers cost?') of interrogatives, and certain types of coordinated interrogatives ('Where is your father? Or your mother?'). We will return to these issues below. For now, we want to remark only the following.

There is no a priori need to suppose that there is a single notion of a question, i.e., only one kind of semantic object that serves as the content of an interrogative. There may be several. Thus Hamblin's picture need not be interpreted as a picture of *the* essential question. One may also look upon it as a specification of the content of a particular type of interrogatives. Of course, our natural tendency would be to look for one type of object to serve as content of all the various kinds of interrogatives

[23] This might be a moot point. Consider the question after the truth of an undecidable mathematical proposition. Or 'paradoxical' interrogatives, such as 'Does the Liar lie?'. But the corresponding indicatives do not fit the standard circumscription of their semantics, either.

[24] Which is no other than the 'Unique Answer Fallacy' of Belnap (see [4]), who obviously was convinced that it is not justified. For the time being we would like to remain neutral on this point, and thus prefer to refer to this feature as an 'assumption', rather than a 'fallacy'.

there are, and, sure enough, uniformity would be an important asset of an analysis. However, the possibility that questions do not form a homogeneous class should not be ruled out. And it should also be borne in mind that an assessment of a proposed analysis in semantics not only depends on its fitting all the relevant empirical facts, but also on its logical simplicity and beauty, and on its conforming to general semantic principles.

Some examples of the latter, which are important for the realm of questions, are discussed in the following section.

4.2. Criteria of adequacy

For a semantics of indicatives, the two most important criteria of adequacy are that it specify a notion of semantical identity (equivalence), and give an account of meaning inclusion (entailment). A semantic analysis is materially adequate to the extent that the equivalence and entailment relations that it accounts for are in accordance with our intuitive understanding of the meanings of the expressions involved.

Similar criteria of adequacy can be formulated for a semantic analysis of interrogatives. Thus, we require that identity criteria for questions be forthcoming, giving rise to an appropriate notion of equivalence between interrogatives. This will allow us to test the proposed analysis against our intuitions concerning when two interrogatives 'pose the same question'. Likewise we want the analysis to specify an appropriate relation of entailment between interrogatives, thus giving an account of when the question posed by one interrogative can be said to be part of the wider question posed by another.

Some decades of thinking about the semantics of indicatives have provided us with reasonably clear judgments on how we want these requirements to be met. The idea of truth conditions, alternative approaches not withstanding, has become entrenched in our intuitions, and serves as a bench mark. Equivalence and entailment defined in terms of truth conditions likewise have become part and parcel of our thinking about the meanings of declarative expressions.

With interrogatives things are perhaps not yet as clear. But something like the role that truth conditions play, is inherent in the relationship between questions and answers. No matter in what particular way we might want to account for it, the notion of a question is intrinsically related to that of an answer. Thus (intuitions about) 'answerhood conditions', though a less familiar item in our semantic vocabulary, seem a good candidate for testing analyses against. Hence, providing an appropriate notion of answerhood can be seen as another criterion for the adequacy of a theory of questions. Such an account links the semantics of indicatives and interrogatives, answers being provided by indicative expressions.

Regarding an account of answerhood as an integral part of one of questions, may also give a firmer grip on the relations of equivalence and entailment between interrogatives. If a semantic analysis specifies an appropriate notion of answerhood between the indicatives and the interrogatives of a language which accords with

our intuitive understanding of when an indicative resolves the question posed by a particular interrogative, then this may give us a test for deciding whether the semantics assigns appropriate meanings to the interrogatives of the language. If two interrogatives are assigned the same meaning, then they should have the same answers under the attested notion of answerhood. And if one interrogative is predicted to entail another, then an indicative which is an answer to the first, should also be an answer to the second.

Note that although being answered by the same indicatives is a necessary condition for the equivalence of two interrogatives, it cannot always be taken to be a sufficient condition (and similarly for the relation between answerhood and entailment). It is only both a necessary and a sufficient condition in case we are dealing with a language of which we can be sure that the questions posed by its interrogatives can always be resolved by the indicatives that can be expressed in the language. To take the extreme case: if two interrogatives have no expressible answers at all, we do not necessarily want to conclude that, hence, they are equivalent.[25]

Expressibility of answers is a traditional topic in erotetic logic, and it is of practical importance for the design of querying systems, where the aim is to make sure that the queries that can be formulated in the language can always be appropriately answered. Likewise, it is important in this context that it is guaranteed that all information that could sensibly be obtained from an information base is expressible in a query. From this perspective one could add as an additional criterion of adequacy for a theory of questions and answers that it can shed light on the issue of expressibility of interrogatives relative to information about a particular domain, and the expressibility of possible answers relative to the interrogatives that can be expressed.

From the same perspective, there are further topics that can be addressed. Even in case a complete answer is not expressible, or when an information base (is 'aware' that it) contains only partial information, it may still be possible to come up with a partial answer. This raises the issue what under such circumstances is an optimal answer. If a semantic theory is to shed light on this, it should give rise to a notion of partial answerhood, and to a comparative notion of when one indicative gives more information about a certain question than another.

Although potentially related to practical applications, these questions can still be thought of as belonging to pure theoretical semantics. At best, answering them could contribute to a 'static' characterization of whether a certain indicative is an optimal reply to a particular interrogative under particular circumstances. A computational semantics of interrogatives should presumably also address the 'dynamic' issue of whether and how one can effectively process a question, decide what the optimal answer is, and produce it in the most understandable way. About these latter issues we will have nothing to say, but about the former we at least hope to indicate that theoretical semantics may have some contribution to make.

[25] As we shall see later on, this is not just a theoretical possibility. If the language of predicate logic is extended with elementary interrogatives, then even very simple and meaningful questions have hardly any expressible answers that completely resolve them. Fortunately, under suitable restrictions expressible answers are forthcoming.

The criteria of adequacy discussed sofar are of a general, framework independent nature. We end this section by formulating some criteria which are peculiar to a particular framework: standard denotational semantics. Within a denotational semantics, the expressions of a language are assigned semantic objects in a systematic compositional way. One may expect of an analysis along these lines that equivalence is determined by sharing the same semantic value, and that whether one expression entails the other depends on whether the value of the first is 'included' in the value of the second. The latter presupposes that the semantic values of expressions within the relevant syntactic categories come with a 'natural' relation of inclusion.[26] Finally, it may be expected that equivalence amounts to mutual entailment. These framework specific principles will be referred to as formal criteria of adequacy.[27] By default, an adequate denotational semantics of interrogatives should be no exception to these rules.

4.3. Adequacy of the Hamblin-picture

That an analysis which conforms to the Hamblin-picture outlined above can be turned into an account that satisfies the adequacy criteria, of course comes as no surprise: it was designed to be that way. In particular, the third postulate forges a strong link between indicative and interrogative, thus making an account of the answerhood relation the heart of the picture. But it will be illustrative to investigate in some detail how this type of analysis complies with these requirements, if only because that will provide us with a handle on the alternatives that will be discussed later.

Since the third postulate establishes a relation between the semantics of interrogatives and that of indicatives, we must start with some assumption concerning the latter. So, suppose indicatives are assigned a proposition as semantic value, where a proposition is taken to be something that 'carves out' a particular part of logical space, viz., the part consisting of those possibilities in which the indicative holds (is true).[28] Without a need for any additional assumptions on what these possibilities are, we can stipulate that one indicative entails another iff the proposition expressed by the first carves out a part of logical space that is contained in the part carved out by the second.

In accordance with the Hamblin-picture as it was developed above, we assume that an interrogative is assigned a partition of logical space (or, alternatively, of that part of it in which its presuppositions hold). The elements of the partition are propositions, viz., those propositions expressed by possible answers. Two interrogatives are then said to be equivalent iff they make the same partition of logical

[26] If the semantic objects are sets, the natural relation is set inclusion.

[27] That these criteria are framework dependent is illustrated by the fact that in dynamic semantics, where the meanings of indicatives are identified with update functions, logical equivalence is not always defined in terms of identity of update functions, but in terms of a weaker equivalence relation.

[28] For convenience sake we assume that the semantics is total, but nothing hinges on this.

space.

Entailment between interrogatives can be defined in the standard way. By '$?\phi$' we indicate an interrogative. Then we define that $?\phi$ entails $?\psi$ iff every element in the partition made by $?\phi$ is included in some element in the partition made by $?\psi$. Recalling that the elements of the partition expressed by an interrogative are intended as the propositions expressed by its answers, we note that if these propositions can be expressed in the language under consideration, this definition boils down to the following: $?\phi$ entails $?\psi$ iff every possible answer to $?\phi$ entails some possible answer to $?\psi$.

This is borne out by the following definition of answerhood. An indicative ϕ is an answer to an interrogative $?\psi$ iff the part of logical space carved out by ϕ is included in some block in the partition of logical space made by $?\psi$. Thus, an indicative answers an interrogative iff it expresses a proposition which entails one of the semantic answers to the question expressed by the interrogative. As required, this notion of answerhood is such that if two interrogatives are logically equivalent then their possible answers are the same. Likewise, if $?\phi$ entails $?\psi$ then every complete answer to $?\phi$ also is a complete answer to $?\psi$. And to the extent that the semantic answers are expressible by the indicatives of the language both implications also hold in the opposite direction.

The notion of answerhood indicated above, is a notion of complete answerhood. Next to this notion of complete answerhood, a notion of partial answerhood can be defined: ϕ partially answers $?\psi$ iff the proposition expressed by ϕ excludes at least one possible answer to $?\psi$. Complete answerhood is a limit of partial answerhood, in which every block in the partition but one is excluded. Partial answerhood determines whether a proposition provides relevant information about a certain question. And, in principle, we can compare answers as to the amount of relevant information that they provide concerning a certain question. On the one hand, the more possible answers are excluded, the better it is. This favors stronger propositions over weaker ones. On the other hand, if two propositions exclude the same possible answers, and one is stronger than the other, the weaker one is to be preferred, since it contains less irrelevant information the question does not ask for. In the end, answers which express propositions which precisely fill one block in the partition that a question makes of logical space will come out as providing the best answers. But one may be forced to compromise, either because one's information simply does not support such an optimal answer, or because the linguistic means to express such an answer effectively are lacking.

We take it that these observations suffice to show that the Hamblin-picture may lead to analyses that satisfy the adequacy criteria. Of course, the empirical import of such accounts still needs to be tested against observations concerning the meanings of actual interrogatives. What we have sketched above are the contours of an analysis, not a full-fledged theory of the semantics of the interrogative structures in a particular language. Two such concrete instances will be discussed below. In the next section we consider the case of a language of propositional logic extended with yes/no-interrogatives. In the subsequent section we discuss the predicate logi-

cal case, and extend the indicative language with elementary interrogatives asking to specify the denotation of a property or relation.

4.4. Questions in propositional logic

Above we have sketched an analysis of questions and answers which remained on a conceptual level and did not make reference to a particular language. In this section we will consider language, albeit a logical one. We will investigate how the language of classical propositional logic can be extended with yes/no-interrogatives.

Syntactically, yes/no-interrogatives are formed by prefixing a question-mark to the formulae of a standard language of propositional logic. So, there are two distinct sentential categories in the extended language: indicatives and interrogatives. The connectives only apply to indicatives. This means that the question-mark can only occur as an outermost operator. Hence, compound interrogatives do not occur in the language under consideration.[29]

The interpretation of the indicative part of the language is classical, i.e., extensional and bivalent. With respect to a model (valuation function), each indicative either denotes the value *true* or the value *false*. And the connectives receive their usual truthfunctional interpretation.

What remains to be decided is how to interpret the interrogatives in the language. Of course, we might let the conceptual framework outlined above guide us here. And in the end the analysis we will come up with does conform to that. However, in the present context it is illuminating to take another route, and observe that it leads to the same result.

Forgetting about the conceptual analysis outlined above, it seems natural to raise the following issue in the present case:

> Is it possible to provide an adequate interpretation for yes/no-interrogatives by extending the standard bivalent *extensional* semantics of propositional logic?

We will argue that this question must be answered in the negative, i.e., we will show that no extensional interpretation of the question-mark operator can be provided that meets the criteria of adequacy formulated above.[30] More in particular, we will show that although it is possible to meet the criteria of material adequacy, the criteria of formal adequacy cannot be met. An extensional interpretation gives rise to materially adequate notions of answerhood, entailment and equivalence. The

[29] When dealing with yes/no-interrogatives, this is no real limitation. Conjunctions of interrogatives, such as 'Does Mary come? And does Peter?', and interrogatives expressing alternative questions, such as 'Does Mary come or Peter?' cannot be answered appropriately by a simple 'yes' or 'no'. And although a conditional interrogative such as 'If Mary comes, does Peter come, too?' can sometimes be so answered, it can also be answered by 'Mary doesn't come', which shows that such interrogatives, too, are not simple yes/no-interrogatives.

[30] Although we present the argumentation against an extensional interpretation with respect to a bivalent (total) interpretation, this is not essential. A similar argumentation can be given against a three-valued (partial) extensional interpretation.

notion of equivalence accounts for the fact that two interrogatives are equivalent iff they have the same answers, but it is not the standard notion under which two expressions are equivalent iff they have the same semantic value.

The argument as such could be stated in a few paragraphs. However, precisely because the extensional analysis is materially fully adequate, we will work it out in some detail. The logical and semantical facts we will discuss with respect to the formally inadequate extensional semantics, will simply go through after the formal deficiencies have been repaired.

4.4.1. Yes/no-semantics

For the indicative part of the language the standard semantics specifies the truth value of an indicative ϕ in a model w as a function of its component parts, in such a way that either $[\phi]_w = 1$ or $[\phi]_w = 0$. Given that interrogatives are built from indicatives, obtaining an extensional interpretation for the question-mark operator means that we have to specify the value of an interrogative $?\phi$ in a model w in such a way that the following extensionality principle holds:

$$[\phi]_w = [\psi]_w \Rightarrow [?\phi]_w = [?\psi]_w$$

Since there are just two possible values for the indicatives, this means that there can be at most two values for the interrogatives. Obviously, opting for a single semantic value has absurd consequences: all interrogatives would be assigned the same meaning. Hence, we must conclude that within a bivalent extensional semantics there are exactly two possible semantic values for yes/no-interrogatives, which, moreover, are one-to-one related to the two truth values.

We cannot identify the semantic values for interrogatives with the truth values, since then there would be no semantic difference between an indicative ϕ and the corresponding yes/no-interrogative $?\phi$. That would bring us back to a position we have already rejected, viz., that the difference between interrogatives and indicatives is not a difference in semantic content, but resides elsewhere.

Hence, $?\phi$ should be assigned one value in case ϕ is true, and another other value, in case ϕ is false. Let us call these values **yes** and **no** respectively.

Definition 4.1 (Extensional interpretation)**.**
$[?\phi]_w =$ **yes** *if* $[\phi]_w = 1$
$\quad\;\; =$ **no** *if* $[\phi]_w = 0$

As long as one remembers that **yes** and **no** are *not* the linguistic expressions 'yes' and 'no'—which do not have counterparts in this logical language, anyway—but arbitrary semantic objects, it will do no harm to refer to them as *answer values*.[31] The use of this terminology highlights that the meanings of interrogatives and indicatives are different: indicatives are related to truth, interrogatives to answers.

[31] One way of interpreting these two values—without introducing new elements in the ontology—is as one-place truth functions: **yes** as the identity function, and **no** as the truth function corresponding to negation. In some systems of erotetic logic, yes/no-interrogatives are interpreted along these lines.

At the same time it enables us to verbalize the semantic content of both categories of sentences in a uniform way: just as the meaning of an indicative lies in its truth conditions, the meaning of an interrogative is given by its answerhood conditions.[32]

4.4.2. Answerhood

One of the criteria of adequacy we encountered above is that the semantics give rise to an appropriate relation of answerhood between indicatives and interrogatives. We define the following notion:

Definition 4.2 (Answerhood)**.**
ϕ is an answer to $?\psi$ iff $\forall w, w'\colon [\phi]_w = [\phi]_{w'} = 1 \Rightarrow [?\psi]_w = [?\psi]_{w'}$.

According to this definition, ϕ is an answer to $?\psi$ iff in all models in which ϕ is true, the answer value of $?\psi$ is the same, i.e., the question $?\psi$ is settled in the set of models in which ϕ is true. For trivial reasons, the contradiction is an answer to any question. However, as one would expect, it can never give a true answer to a question.

Although our basic argument in this section is that an extensional interpretation does not provide us with an adequate semantic analysis of yes/no-interrogatives, the following fact shows that the notion of answerhood that it gives rise to is materially adequate:

Fact 4.3. *ϕ is an answer to $?\psi$ iff $\phi \models \psi$ or $\phi \models \neg\psi$*

This fact shows that both ϕ and $\neg\phi$ are possible answers to $?\phi$.

Note that the syntax of the language guarantees that if an interrogative $?\phi$ is is a well-formed expression, then so are ϕ and $\neg\phi$. In other words, the possible complete answers to any yes/no-interrogative are expressible.

4.4.3. Formal inadequacy

The expressibility of possible answers gives us the means to test the adequacy of the analysis by checking whether the following fact holds:[33]

Fact 4.4. *$?\phi$ and $?\psi$ are logically equivalent iff $?\phi$ and $?\psi$ have the same answers.*

From the previous fact, we can immediately see:

Fact 4.5. *$?\phi$ and $?\neg\phi$ have the same answers.*

[32] Note that—whatever is wrong with it—it does not make sense to object that the yes/no-semantics is a 'reductive analysis of questions in terms of answers'. The mere fact that we refer to the semantic values of interrogatives as 'answers' is irrelevant. If that would constitute a reduction of questions to answers, then a truth conditional semantics for indicatives would be a reduction of propositions to truth values.

[33] Recall from our discussion of the adequacy criteria that if some answers are not expressible, having the same answers is not sufficient for being equivalent.

Hence, if our semantics is to be adequate it should support the fact that $?\phi$ and $?\neg\phi$ are logically equivalent. Under the standard notion of equivalence this requires that $\forall w\colon [?\phi]_w = [?\neg\phi]_w$. But quite the opposite holds for an extensional yes/no-semantics: in each model $?\phi$ and $?\neg\phi$ have *a different* value, if the answer value of the one is **yes**, the answer value of the other is **no**.

This shows that an extensional semantics for yes/no-interrogatives, although it meets the criterion of material adequacy, viz., that it give rise to an appropriate notion of answerhood, is inadequate. It fails to meet the formal criterion that within a denotational semantics, logical equivalence amounts to identity of semantic value in each model.

4.4.4. Non-standard equivalence and entailment

In the present set-up there are two answer values, and the interrogatives $?\phi$ and $?\neg\phi$ have a different value in each model. What do they then have in common? Their *value pattern* over the set of models is the same. And in fact, this characterizes when two yes/no-interrogatives have the same possible answers:

Fact 4.6.
$?\phi$ and $?\psi$ have the same answers iff $\forall w, w'\colon [?\phi]_w = [?\phi]_{w'} \Leftrightarrow [?\psi]_w = [?\psi]_{w'}$.

This observation immediately supplies us with a materially adequate criterion of identity of semantic content of two interrogatives:

Definition 4.7 (Non-standard equivalence)**.**
$?\phi$ is logically equivalent with $?\psi$ iff $\forall w, w'\colon [?\phi]_w = [?\phi]_{w'} \Leftrightarrow [?\psi]_w = [?\psi]_{w'}$.

The notion of equivalence suggests the following non-standard notion of entailment:

Definition 4.8 (Non-standard entailment)**.**
$?\phi$ entails $?\psi$ iff $\forall w, w'\colon [?\phi]_w = [?\phi]_{w'} \Rightarrow [?\psi]_w = [?\psi]_{w'}$.

This notion meets the standards that equivalence amounts to mutual entailment, and it supports the following fact, which shows its material adequacy:

Fact 4.9. *$?\phi$ entails $?\psi$ iff every answer to $?\phi$ is an answer to $?\psi$.*

The relations of equivalence and entailment are characterized by the following facts:

Fact 4.10.
(i) *$?\phi$ entails $?\psi$ iff $\phi \equiv \psi$, or $\phi \equiv \neg\psi$ or ψ is non-contingent.*
(ii) *$?\phi$ is logically equivalent with $?\psi$ iff $\phi \equiv \psi$ or $\phi \equiv \neg\psi$*

So, the only 'interesting' pair of equivalent interrogatives are $?\phi$ and $?\neg\phi$. Entailment between yes/no-interrogatives differs minimally from equivalence and is also rather 'poor'. We have already seen that $?\phi$ and $?\neg\phi$ are equivalent, so, obviously, they also entail each other. The only other entailment relation that is of interest is that any interrogative entails both $?(\phi \vee \neg\phi)$ and $?(\phi \wedge \neg\phi)$. Both have the entire space of possibilities as the only block in the partition they make. And we might

just as well call both interrogatives tautological as well. Any question includes the tautological question.

Entailment between interrogatives does not mirror entailment between the corresponding indicatives. For example, although $\phi \wedge \psi$ entails ϕ, not *every* answer to $?(\phi \wedge \psi)$ is an answer to $?\phi$. For, although $\neg(\phi \wedge \psi)$ is an answer to $\phi \wedge \psi$, it is not an answer to ϕ. Of course, $\phi \wedge \psi$ is an answer to both.

The poverty of the entailment relation between yes/no-interrogatives reflects that they are the atoms in the question-hierarchy induced by the entailment relation. Since there are no complex interrogatives in the language, this was to be expected.

4.4.5. An intensional semantics for yes/no-interrogatives

All seems well with the extensional semantics for yes/no-interrogatives, except for one flaw, viz., that equivalence cannot be defined in terms of having the same semantic value and that entailment cannot be defined in terms of inclusion of semantic values.

Note that the identity criterion as formulated in the definition of non-standard equivalence, can also be written as follows:

$$\forall w\colon \{w' \mid [\phi]_{w'} = [\phi]_w\} = \{w' \mid [\psi]_{w'} = [\psi]_w\}.$$

This means that if $\{w' \mid [\phi]_{w'} = [\phi]_w\}$, the set of models where ϕ has the same truth value as in w, can be taken to be the semantic value of $?\phi$ in w, equivalence can be defined in terms of having the same semantic value in each model, and entailment as inclusion of semantic values.

However, we cannot proceed in exactly this fashion. One cannot specify the semantic value of an expression *within* a certain model by referring to *other* models. An easy and standard way to get around this is to introduce the notion of a *possible world*. We identify a world w with what we used to call a model. And a model M is now a set of possible worlds. The extension of an indicative ϕ relative to a model M and a world w, $[\phi]_{M,w}$, is the truth value assigned by w to ϕ. The intension of ϕ in a model M is the set of worlds in M in which ϕ is true: $[\phi]_M = \{w \in M \mid [\phi]_{M,w} = 1\}$. A set of worlds is called a proposition, $[\phi]_M$ is the proposition expressed by ϕ in M. ϕ entails ψ iff in every model M the proposition expressed by ϕ in M is included in the proposition expressed by ψ in M, i.e., $\phi \models \psi$ iff $\forall M\colon [\phi]_M \subseteq [\psi]_M$. The interpretation of the indicative part of the language consists in a recursive specification of the extension of the indicatives of the language relative to a model and a world.

Having thus set the stage, and using the observation made above, we are ready to state the intensional interpretation of interrogatives:

Definition 4.11 (Intensional interpretation)**.**
$[?\phi]_{M,w} = \{w' \in M \mid [\phi]_{M,w'} = [\phi]_{M,w}\}$

The extension of an interrogative in a world w is an intensional object, a proposition. It is the proposition expressed by ϕ in case ϕ is true in w, and the proposition expressed by $\neg\phi$ in case ϕ is false in w. I.e., the extension of a yes/no-interrogative is the proposition expressed by a complete and precise answer to the question

posed by the interrogative. We can identify the intension of $?\phi$ in a model M, the question expressed by $?\phi$ in M, with the set of its possible extensions in M: $[?\phi]_M = \{[?\phi]_{M,w} \mid w \in M\}$. The propositions in the set are mutually exclusive, and exhaust the logical space consisting of all possible worlds in M. In other words, we have arrived at Hamblin's picture of the notion of a question as a partition of logical space: a bipartition in the case of (non-tautological) yes/no-interrogatives.

This analysis is both materially and formally adequate, as the following observations show. Entailment and logical equivalence between interrogatives, can be defined in the standard way:

Definition 4.12 (Entailment and equivalence)**.**
(i) $?\phi \models ?\psi$ *iff* $\forall M, \forall w \in M\colon [?\phi]_{M,w} \subseteq [?\psi]_{M.w}$
(ii) $?\phi \equiv ?\psi$ *iff* $\forall M, \forall w \in M\colon [?\phi]_{M,w} = [?\psi]_{M,w}$

Two interrogatives are equivalent iff they always partition the logical space in the same way. An interrogative $?\phi$ entails an interrogative $?\psi$ iff every block in the partition made by $?\phi$ is always included in a block of the partition made by $?\psi$. It cannot hold of two different bipartitions of the same logical space that every block in the one is part of some block in the other. Hence, only equivalent contingent interrogatives entail each other. And any interrogative entails the tautological interrogative, which corresponds to a partition which always has only one element, a single block consisting of the logical space as a whole.

The relation of answerhood between indicatives and interrogatives is defined as follows:

Definition 4.13 (Answerhood)**.** $\phi \models ?\psi$ *iff* $\forall M \exists w \in M : [\phi]_M \subseteq [?\psi]_{M,w}$

In terms of the partition $?\psi$ makes on M, this expresses that ϕ is an answer to $?\psi$ iff the proposition expressed by ϕ in M is always a (possibly empty) part of one of the blocks in the partition made by $?\psi$.

The facts observed above in working out the extensional interpretation, concerning the relations between answerhood, entailment and equivalence remain in force, and will not be repeated. This illustrates once more that what we gain in the intensional approach is not material, but only formal adequacy. However, at the same time we hope, that it also shows, that formal adequacy enhances conceptual clarity.

4.4.6. Remark on coordination

An additional criterion of adequacy that can be imposed on a semantic analysis of interrogatives is that it can deal with coordination of interrogatives. Material adequacy requires that answerhood and entailment relations are appropriately accounted for. Formal adequacy requires that conjunction and disjunction of interrogatives are analyzed in the standard way in terms of intersection and union.[34]

How does the semantics presented above fare if we add coordinated interrogatives to the language? Conjunction of interrogatives ('Will John be there? And will

[34] See [22, 23] for a more detailed discussion.

Mary be there?') can be interpreted in a standard way: the pairwise intersection of the blocks in two partitions results in another partition. By simply conjoining the possible answers to two interrogatives, we obtain the propositions that answer their conjunction. The extension of a conjunction of two interrogatives can be defined standardly in terms of the intersection of the extensions of the conjuncts. The notions of entailment and answerhood as they were defined above give the appropriate results. E.g., a conjunction of two interrogatives will entail each of its conjuncts. And an indicative is an answer to a conjunction of two interrogatives iff it is an answer to each of its conjuncts.

Disjunction of interrogatives ('Will John be there? Or Mary?') however, is another matter. To see why, it suffices to observe that taking the pairwise union of the blocks in two partitions, will usually not result in a new partition. We cannot identify the extension of the disjunction of two interrogatives with the union of the extensions of its disjuncts. It would make the wrong predictions with respect to entailment and answerhood relations.

This corresponds to the fact observed above that disjunctions of interrogatives are peculiar: they violate the Unique Answer Assumption, and it has been argued[35] that a disjunction of interrogatives, unlike a conjunction, does not express a single question. More on this below.

4.4.7. Remark on natural language

In natural language, 'negative' yes/no-interrogatives do not behave precisely the same as the interrogatives of the form $?\neg\phi$ in our logical language. Compare the following sequence: 'Is John at home? Yes (he is)./No (he isn't)', with: 'Is John not a home? Yes, (of course) he IS./No (he isn't)'. Whereas whenever $?\phi$ has a 'positive' value $?\neg\phi$ has a 'negative' value, the English interrogatives in both sequences receive the same negative answer, and the same positive answer, except for the fact that as a reply to the negative interrogative, a positive answer is marked.

The pair of logical interrogatives and the pair of English interrogatives do have in common that they express the same question. However, by using the negative interrogative in the second sequence the questioner also expresses that she is afraid to get a negative answer to the question whether John is at home. That explains why a positive answer is marked by emphatic elements.

So, the negative linguistic element in the second sequence does not play its usual logical role of negation, but rather has a pragmatic function. One could bring forward that it is precisely the fact that from a logical semantic point of view $?\phi$ and $?\neg\phi$ express the same question, that creates the possibility for this process of pragmatic recycling of the element of negation.

[35] See, e.g., [4, 22].

4.5. The predicate logical case

In the previous section we only considered interrogatives which can be answered by a simple 'yes' or 'no'. Another basic type of interrogatives are constituent interrogatives such as 'Which students passed the test?', which is typically answered by listing the students that actually passed the test. One can look upon such interrogatives as asking for a characterization of the actual denotation of a particular property in case of one-constituent interrogatives, and of a relation in the case of multiple constituent interrogatives such as 'Who plays with whom?'.

Besides the possibility that constituent interrogatives ask for an exhaustive characterization of a property or relation, there is also the option that they ask to mention just one or some other number of instances. Here, we will only consider the mention all interpretation, but we will return to the mention-some interpretation later on.

Properties and relations (between ordinary first order objects) is what predicate logic is all about, and it makes sense to consider the possibility of extending the language of predicate logic with interrogatives which inquire after which objects have certain properties and stand in certain relations.

To be able to formulate such interrogatives, it suffices to add the following rule to the syntax of predicate logic:[36]

Definition 4.14 (Syntax)**.**
Let ϕ be a formula in which all and only the variables $x_1, \ldots, x_n$ ($n \geq 0$) have one or more free occurrences, then $?x_1 \ldots x_n\phi$ is an interrogative formula.

As was the case in the propositional language, and for similar reasons, we leave complex interrogatives, including quantification into interrogatives, out of consideration.[37]

Since the rule allows for zero variables to be 'queried over', yes/no-interrogatives are just a special case. Thus we obtain interrogatives such as $?\exists x(Px \wedge Qx)$, asking whether or not there is some object that has both the property P and the property Q. As in the case of propositional logic, there are only two possibilities to be

[36] For ease of presentation, we don't allow for vacuously 'querying over' a variable, and neither do we allow that interrogative formulae contain occurrences of free variables. Notice also that variables are queried over in one fell swoop, rather than one by one. The latter construction would require a syntactic rule which turns interrogatives into interrogatives. Going about the way we do here, is not a matter of principle, but of convenience.

[37] This means that, as compared to natural language, the language under consideration has limited means of expressing questions, even with respect to the particular domain it is suited for. Not only coordination of interrogatives occurs in natural language, but an interrogative sentence like 'Which student did each professor recommend?' has an interpretation where it asks to specify for each professor which student (s)he recommended. This reading, under which the sentence can be paraphrased as 'Which professor recommended which student?', seems to correspond to universal quantification into an interrogative. (But see the discussion of such cases below, page 65.) In another sense, however, it is guaranteed that any question concerning (simple and complex) relations between objects that can be formulated in the indicative part of the logical language is expressible. The paraphrase we gave of the example that seems to involve quantification into interrogatives is a case in point.

discerned.

With the aid of the same rule, we can also form interrogatives such as $?x(Px \wedge Qx)$, which is be interpreted as asking for a characterization of the extension of the complex property of being both P and Q, i.e., as asking for a complete specification of those objects which have both properties. In this case the number of possibilities equals that of the number of sets of objects that can be the value of the conjunctive predicate.

Notice that whenever the question posed by $?x(Px \wedge Qx)$ is answered, the question put by $?\exists x(Px \wedge Qx)$ is answered, too. That there are no objects that have both properties is one possible answer to the first question, which at the same time provides a negative answer to the second question. Any other possible answer to the first question, specifying some non-empty set of objects as having both properties, would at the same time imply a positive answer to the yes/no-question.[38] This means that an adequate semantics should account for the fact that $?x(Px \wedge Qx)$ entails $?\exists x(Px \wedge Qx)$.

Notice furthermore that an indicative like $(Pa \wedge Qa) \wedge (Pb \wedge Qb)$ does not count as a (complete) possible answer to $?x(Px \wedge Qx)$. The proposition expressed by that sentence only informs us that *at least* the objects denoted by a and by b have both properties, and thereby still leaves open many different possibilities for the extension of the conjunction of both properties. A question like 'Which students passed the test?' can typically be answered by 'Alfred and Bill (passed the test)', but such an answer equally typically conveys the information that *only* the students Alfred and Bill passed the test. Hence, a better candidate for a complete answer is $\forall x((Px \wedge Qx) \leftrightarrow (x = a \vee x = b))$, which specifies the extension of the conjunction of the two properties to consist only of the objects denoted by a and b. However, this will still only inform us about which *objects* have both properties to the extent that we already know which objects are denoted by a and b.

The question which object is denoted by a particular constant is posed by an interrogative like $?x(x = a)$. It asks the question who a is.[39] Again, an indicative like $\exists x(\forall y(Py \leftrightarrow x = y) \wedge x = a)$, 'a is the object which has property P', will only inform us about the identity of a to the extent that we are informed about which is the unique object that has the property P.

As a last example consider the interrogative $?xyRxy$. It asks for a specification of the extension of the relation R, i.e., it is answered by a specification of a set of pairs of objects which stand in the relation R. Obviously, whenever $?xyRxy$ is answered, $?yxRxy$ is answered also, and vice versa. Knowing who loves whom and knowing whom is loved by whom amount to the same thing. This means that an adequate semantics should account for the logical equivalence of these two interrogatives.

[38] So, interrogatives of the form $?x\phi$ are not interpreted as having an existential presupposition. That no objects exist that satisfy ϕ is taken to be one possible answer equal among the others.

[39] This is one of the meanings that natural language interrogatives of the form 'Who is A?' may have. See, e.g., [38, 10] for discussion.

4.5.1. Intensional interpretation

If only because yes/no-interrogatives are part of the language under consideration, the argument against an extensional interpretation of interrogatives given above remains in force. As in the propositional case, it also holds for the predicate logical language that we can provide an extensional interpretation, and define notions of answerhood, entailment and equivalence which do give appropriate results, but only fail to meet the formal criterion that equivalence be defined in terms of identity, and entailment in terms of inclusion of semantic values. We will not pursue this line, but immediately present the formally adequate intensional interpretation.

As before, a model M will be identified with a set of worlds, but now, a world w is identified with an ordinary first order model, consisting of a domain and an interpretation function, assigning values to the non-logical constants of the language, relative to the domain.[40] For the indicative part of the language, the extension $[\phi]_{M,w,g}$ of a formula ϕ with respect to a model M, a world w, and an assignment g is defined in the usual way.

Interrogatives are interpreted as asking for a specification of the actual extension of a particular relation. Relative to a a world and an assignment, the extension of the relation an interrogative $?x_1 \ldots x_n\phi$ asks to specify, is defined as follows:[41]

Definition 4.15 (Relational interpretation)**.**
$\langle ?x_1 \ldots x_n\phi\rangle_{M,w,g} = \{\langle g'(x_1), \ldots, g'(x_n)\rangle \mid [\phi]_{M,w,g'} = 1$, *where* $g'(x) = g(x)$, *for all* $x \neq x_1 \ldots x_n\}$

Note that in case $n = 0$, which is the case of yes/no-interrogatives, $\langle ?\phi\rangle_{M,w,g} = [\phi]_{M,w,g}$. Hence, the intensional interpretation of yes/no-interrogatives as given above now amounts to

$$[?\phi]_{M,w,g} = \{w' \in M \mid [\phi]_{M,w',g} = [\phi]_{M,w,g}\}$$

The same schema gives appropriate results also for $n > 0$, collecting all the worlds in the model where the extension of the relation the interrogative asks to specify is the same as in the actual world w. Hence, using $?\phi$ as a meta-variable ranging over all the interrogatives of the predicate logical language, the intensional interpretation is given by:

Definition 4.16 (Intensional interpretation)**.**
$[?\phi]_{M,w,g} = \{w' \in M \mid \langle ?\phi\rangle_{M,w',g} = \langle ?\phi\rangle_{M,w,g}\}$

For example, the extension of $?xPx$ in a world w will be the set of all worlds in which the same objects belong to the extension of the predicate P. This set of

[40] One can look upon these models as possible information states of an agent. Each possible world in a model is a way the world could be according to the information of the agent.

[41] This relational interpretation can be taken as the extensional interpretation of interrogatives in a predicate logical language. If we do so, and use analogues of the definitions of answerhood, entailment, and equivalence as they were defined with respect to the extensional interpretation of the propositional language, then we arrive at a materially adequate analysis, which only fails to meet the formal criteria concerning the notions of entailment and equivalence.

worlds corresponds to the proposition which exhaustively characterizes the positive extension of the property P in world w. The intension $[?xPx]_M$ of $?xPx$ is then identified by the set of mutually exclusive propositions, each of which characterizes a possible extension of the predicate P relative to the model M. Their union exhausts the logical space, the set of all worlds in the model. Hence, the question expressed by $?xPx$ fits the Hamblin picture: it is a partition of logical space. There are as many blocks in the partition as there are possible extensions of the predicate P within in the model.

In general, the partition induced by an interrogative $?x_1 \ldots x_n\phi$ will consist of as many blocks as there are possible extensions of the underlying n-place relation. And each block corresponds to a proposition which characterizes a possible extension of that relation.

Partitions can be visualized in diagrams. Figure 1 illustrates the bipartition made by a yes/no-interrogative, figure 2 is an example of a partition made by a one-constituent interrogative.

ϕ
not-ϕ

Figure 1. Partition made by $?\phi$

nobody Px
a_1 is the one that Px
a_2 is the one that Px
a_1 and a_2 are the ones that Px
$\vdots$
everybody Px

Figure 2. Partition made by $?xPx$

4.5.2. Entailment and equivalence
The definition of entailment can remain 'literally' the same as in the propositional case, but we formulate it in a more general way:

Definition 4.17 (Entailment)**.**
(i) $?\phi_1, \ldots ?\phi_n \models_M ?\psi$ *iff* $\forall w \in M\colon [?\phi_1]_{M,w} \cap \ldots \cap [?\phi_n]_{M,w} \subseteq [?\psi]_{M,w}$.
(ii) $?\phi_1, \ldots ?\phi_n \models ?\psi$ *iff* $\forall M\colon ?\phi_1, \ldots ?\phi_n \models_M ?\psi$

The interrogatives $?\phi_1 \ldots ?\phi_n$ entail the interrogative $?\psi$ in a model M iff any proposition which completely answers all of $?\phi_1 \ldots ?\phi_n$ in M, also completely answers $?\psi$ in M. Logical entailment amounts to entailment in all models. Equivalence can be defined as mutual entailment between two interrogatives.

Consider the following facts, which are related to observations made above:

Fact 4.18.
(i) $?xPx \models ?\exists xPx$.
(ii) $?xPx \models_M ?Pa$, *if* $\models_M ?x(x = a)$.
(iii) $?xPx, ?x(x = a) \models ?Pa$.
(iv) $?xPx \models_M ?x\neg Px$, *if* $\models_M ?x(x = x)$.
(v) $?xPx, ?x(x = x) \models ?x\neg Px$.
(vi) $?xyRxy \equiv ?yxRxy$.

As is indicated by (i), in any model, a complete answer to the question who will be at the party cannot fail to provide a (positive or negative) answer to the question whether there will be someone at the party. As (ii) indicates, however, it does not hold quite generally that any complete answer to the question who will be at the party always provides an answer to the question whether Alfred will be at the party, too. The entailment only obtains when we restrict ourselves to a proper subset of the set of all possible models, those models in which the question who Alfred is, is already settled. Knowing who will be at the party does not imply knowing whether Alfred will be there, unless we know the answer to the question who Alfred is. Another way of saying this, as (iii) indicates, is that whenever both the question who will be at the party and the question who Alfred is are answered, the question whether Alfred will be at the party is answered, too.

Similarly, as (iv) and (v) tell us, knowing who will be at the party, is not the same as knowing who will not be there, unless we know which particular set of objects we are talking about. The latter question, of what there is, is expressed by $?x(x = x)$. Note that whereas $?\forall x(x = x)$ expresses a tautological question (i.e., $\models ?\forall x(x = x)$), $?x(x = x)$ does not. It only does so if we restrict ourselves to models which consist of worlds with share the same domain.

On the relational interpretation of interrogatives, the standard notion of entailment in terms of (set) inclusion, would not enable us to account for these entailments and equivalences. In general, entailments and equivalences between interrogatives which ask for the specification of relations with different numbers of arguments can not be accounted for. The (restricted) entailment between $?xPx$ and $?Pa$ is a case in point. And even with respect to two relations with the same number of arguments, one would arrive at the wrong results. We know this already from the

case of yes/no-interrogatives, but the equivalence of $?xyRxy$ and $?yxRxy$, stated in (vi), is equally telling. And yet another case is the equivalence of $?xPx$ and $?x\neg Px$, restricted to a model in which the worlds share the same domain. Finally, for a case like $?x(Px \wedge Qx)$ and $?xPx$ we would predict wrongly that the first entails the second.

4.5.3. Answerhood

Answerhood is defined in essentially the same way as in the propositional case, except that we explicitly define a notion of answerhood restricted to a particular model, and in terms of that the more general notion of 'logical' answerhood:[42]

Definition 4.19 (Answerhood)**.**

(i) $\phi \models_M ?\psi$ *iff* $\exists w \in M\colon [\phi]_M \subseteq [?\psi]_{M,w}$.

(ii) $\phi \models ?\psi$ *iff* $\forall M\colon \phi \models_M ?\psi$

Consider the following facts, related to the examples discussed above:

Fact 4.20.

(i) $\neg\exists xPx \models ?xPx$

(ii) $\forall xPx \models_M ?xPx$, *if* $\models_M ?x(x = x)$

(iii) $\forall x(Px \leftrightarrow x = a) \models_M ?xPx$, *if* $\models_M ?x(x = a)$.

(iv) $\forall x(Px \leftrightarrow Qx) \models_M ?xPx$, *if* $\models_M ?xQx$.

(v) $\forall x(Px \leftrightarrow x = a) \models_M ?x(x = a)$,*if* $\models_M ?xPx$.

These facts indicate that, unlike yes/no-interrogatives, constituent interrogatives do not always have expressible answers. We need expressions (or non-linguistic means) that identify (sets of) objects in order to be able to 'really' specify the extensions of properties and relations. For example, the fact that $\forall x(Px \leftrightarrow x = a)$, 'only a has the property P', is a complete answer to $?xPx$ in a model in which the question $?x(x = a)$ is already settled, reflects that it provides us with a *nominal* answer, and not with a *real* answer, unless we know already who a is.[43]

But observe that, even in case one has no idea who a is, the answer $\forall x(Px \leftrightarrow x = a)$ does provide information which is relevant to the question posed by $?xPx$. It tells us that there is an object which has the property P, that there is only one such object, and that it bears the name a. Thus, it excludes many possible answers, and it creates a new link between the questions posed by $?xPx$ and $?x(x = a)$: if the one gets answered, the other is answered also. Similarly, it can be observed

[42] If we view a model as an information state, then $\phi \models_M ?\psi$ can be read as: in the information state M' which results from updating M with ϕ, the question $?\psi$ is settled. A logical answer is such that it answers the question with respect to any information state. Similar remarks can be made about entailment and equivalence.

[43] The distinction between real and nominal answers goes back to (at least) Belnap and Steel ([5]), where one can also find the observation that in many situations a nominal answer is all that is called for. Note that being provided with a real answer to the question expressed by an interrogative like $?xPx$ does not require that names for the objects in question be available, or that we be able to draw up a (finite) 'list' of such objects. A characterization in terms of a simple or complex predicate can provide a real answer as long as it rigidly specifies a certain set of objects.

that in case $\forall xPx$ or $\forall x(Px \leftrightarrow Qx)$ does not provide a complete answer to $?xPx$, it may still provide a useful partial answer by excluding many possibilities.

4.5.4. Comparing answers

Instead of defining a notion of partial answerhood as such, in terms of excluding certain possibilities, we concentrate on a notion which compares indicatives as to how completely and precisely they answer a certain question. First we define an auxiliary comparative notion of informativeness, which leaves precision out of consideration.

Definition 4.21 (Informativeness)**.**

(i) *ϕ gives a partial true answer to $?\psi$ in w in M iff $[\phi]_M \cap [?\psi]_{M,w} \neq \emptyset$.*

(ii) *ϕ is a more informative answer to $?\psi$ in M than ϕ' iff $\forall w \in M$: if ϕ gives a partial true answer to $?\psi$ in M in w, then ϕ' does, too.*

The auxiliary notion of giving a partial true answer is a very weak one: ϕ gives a partial true answer in w in M iff ϕ overlaps with the block in the partition in which w is situated. In particular, it is not required that ϕ itself be true in w, only that it be compatible with the actual true answer. Neither is it required that ϕ exclude any possible answers. Thus, even the tautology counts as a partial true answer.

Notice that the comparative notion of being a more informative answer does favor indicatives which exclude more possible answers. The contradiction then turns out to be the most informative answer to any question. Disregarding that, the most informative answers to $?\psi$ are complete answers, i.e., those ϕ such that $\phi \models ?\psi$. If ϕ and ϕ' imply the same possible answer to $?\psi$, they count as equally informative relative to the question. In terms of the absolute notion of informativeness, i.e., entailment, the one may be more informative than the other, or the one may imply the negation of the other, or they may be incomparable. If ϕ and ϕ' imply different possible answers to $?\psi$, they are unrelated with respect to their informativeness relative to $?\psi$.

Partial true answerhood and relative informativeness are put to use in the following definition, which also takes the precision of answers into consideration (the obvious relativization to a model M and a world w are omitted).

Definition 4.22 (Comparing answers)**.**

Let ϕ and ϕ' give a true partial answer to $?\psi$. Then ϕ is a better answer to $?\psi$ than ϕ' iff

(i) *ϕ is a more informative answer to $?\psi$ than ϕ'; or*

(ii) *ϕ and ϕ' are equally informative answers to $?\psi$ and ϕ is properly entailed by ϕ'.*

According to the first clause, among the true partial answers the more informative ones, which exclude more possible answers, are preferred. The second clause favors weaker answers among equally informative ones. The sum effect is that the answer that equals that block in the partition which contains the actual world is the most preferred. Next are those answers which are inside that block, but do not fill it

completely. This means that such answers contain additional information that the interrogative does not ask for. This lack of precision is not as harmless as it may seem. An answer which *gives* a complete (or partial) true answer need not express a true proposition itself. The precise true and complete answer which fills the whole block is guaranteed to do so. Stronger, and hence over-informative answers, can express false propositions themselves. I.e., although with respect to the question posed by the interrogative they provide correct information, at the same time they may provide incorrect information with respect to some other question. This is precisely why the comparison of answers favors weaker propositions among the ones that give the same answer.

Of course, the available information may simply not support such a complete answer, in which case a partial answer is all that can be offered. The effect of the comparison is that among the answers supported by the information, those are selected that are incompatible with all possible answers incompatible with the information. There again, even though the available information may support stronger propositions, the comparison prefers the unique partial answer that completely fills the union of the blocks corresponding to the possible answers compatible with the information. Again, there is a good reason for this. The information as a whole may be incorrect at some points. But still, it may support a true partial (or complete) answer to some questions. Providing more information than an interrogative asks for, means answering other questions at the same time. But the answer given to those might very well be false. The comparison cautiously tries to prevent this.

Besides partiality of information there is another reason why proper complete (or partial) answers may not be available: it might be that they are not expressible in the language. (Or not expressible relative to the information. In discussing the notion of answerhood, we have seen that in the predicate logical case this can easily occur.) In these cases, too, we have to make do with partial or over-informative answers which are expressible, among which a choice needs to be made. In particular, to be able to provide proper answers, expressions are needed that (with respect to the information available to the questioner) rigidly identify (sets of) objects. If such expressions are lacking, a comparison among the available answers is called for. Hence, such a comparison is a necessary ingredient of any theory of questions and answers.[44]

4.5.5. Remark on natural language

It should be noted that, unlike in natural language, in this predicate logical system querying over variables is unrestricted. In natural language, however, this almost never the case. A *wh*-phrase is usually of the form *which* CN, and even for those phrases which lack on overt CN, such as *who*, *what*, it can be argued that they are in fact restricted.

Taking our lead from quantification in standard predicate logic, we might think that restricted querying can be expressed by means of conjunction: 'Which P are

[44] See [22] for some more discussion of this issue.

Q?' would be turned into $?x(Px \wedge Qx)$. In most cases this representation is adequate, but there is a snag here. Consider the following pair of sentences:[45] 'Which men are bachelors?', 'Which bachelors are bachelors?'. Clearly, the first sentence poses a non-trivial question, which is adequately represented by $?x(Mx \wedge Bx)$. The second sentence, is trivial: it asks the tautological question. However, its representation, $?x(Bx \wedge Bx)$, is equivalent to $?xBx$, which is not trivial at all: it asks who the bachelors are. Clearly, a real extension of the syntax of the representation language is called for, if we are to deal with these cases.

*

Up to this point we have been concerned mainly with developing an argument that purports to show that a semantic analysis of interrogatives is a viable subject. The outlines of one particular approach, based on the three Hamblin postulates, have been sketched, using two simple formal languages as pedagogical devices. But other approaches have been developed in the literature. In the remainder of this chapter we will discuss them under two headings: logical and computational theories, and linguistic theories.

5. Logical and computational theories

Although related, logical and computational theories are discussed separately, since, as we shall see, their focus is somewhat different.

5.1. Logical theories

Historically,[46] the study of interrogatives started out on logical premises. This is not surprising: the enterprise of a systematic formal semantics for natural language is of fairly recent date, and with the development of modern formal logic at the beginning of the twentieth century, it was only natural that some would want to try to extend its scope to include non-indicative expressions, among which interrogatives occupy a prominent position. Not that it was a subject which instantly drew massive attention. Except for a few isolated attempts, it was only in the fifties[47] that regular logical theorizing about interrogatives started to come off the ground, with the work of Prior & Prior ([46]). Of particular importance has been the work of Hamblin, Harrah, Åqvist, Hintikka, and Belnap.[48]

[45] The example is due to Stanley Peters.

[46] See [14] for an extensive bibliography which runs up to 1975.

[47] Which also saw the rise of the computer, electronic data storage, etc. As will become clear, this was one important reason for the new interest in a logic of questions.

[48] Later work of the latter two authors witnessed an increasing interest in natural language structures. This change of focus occurred in seventies, when formal approaches to natural language semantics, such as Montague grammar, started to develop. It was in that framework that the first attempts at giving a systematic semantics of natural language interrogatives were made, first by Hamblin ([27]), followed by Karttunen ([40]), and later by Belnap ([4]), and others.

Although often inspired by observations concerning natural language, logical theories were occupied with different concerns. The main objective of the work done in this tradition is to provide a set of formal tools, adequate for a formalization and subsequent analysis of the concepts of question and answer, and the relationships between them. Quite often, the analysis is set against the background of possible applications, in the sphere of question-answering, or information retrieval. Thus from the outset the concept of a 'data-base' plays a role: a typical picture is that of a questioner formulating a query, and a questionee 'looking up' the answer in a data-base and formulating it in an adequate response, which effectively answers the questioner's query.[49] It is remarkable to note that many issues that form the core of important current developments in semantics and cognitive science, such as the dynamics of meaning, update and revision of belief, are already present in these early analyses, albeit not in the form in which they shape the debate today.

This picture sets the agenda of much of the logical research. It is concerned with *expressibility* and *effectivity*, i.e., with the development of a formal language in which various types of queries and the different kinds of answers they call for, can be expressed and communicated in an effective way. The starting point in most cases is some familiar first order language, to which interrogative expressions are added and in which answers can be expressed. This language is then provided with a semantics, thus providing formal counterparts of the pre-theoretic notions to be analyzed. Remarkably, proof theoretic aspects are by and large ignored.[50]

Most logical approaches start from assumptions quite similar, and sometimes identical, to the Hamblin postulates which were taken as a starting point above (see section 4.1).[51] Thus, questions are closely associated with answers. But in some approaches the link is not that tight. This holds especially for the analyses in the epistemic-imperative paradigm, such as those of Hintikka and Åqvist, which, as was

[49] See [28, p. 725] where this perspective is introduced and discussed explicitly.

[50] Thus Belnap and Steel ([5, p. 1]):

> What is the logic of questions and answers? [...] Absolutely the wrong thing is to think it is a logic in the sense of a deductive system, since one would thus be driven to the pointless task of inventing an inferential scheme in which questions, or interrogatives, could serve as premises and conclusions. This is to say that what one wants erotetic logic to imitate of the rest of logic is not its proof theory but rather its other two grand parts, grammar (syntax) and semantics.

This is remarkable since, as was stressed above, entailment relations between interrogatives do exist, and need to be accounted for in an adequate semantics. This being the case, there seems to be no reason to exclude a priori the possibility of a (partial) syntactic characterization of both entailment between interrogatives, and the answerhood relation.

Also, it should be noted that many logical analyses are involved in syntactic issues, in this sense that the design of an adequate language, and the definition of various logical forms, is one of their main concerns.

[51] According to Belnap & Steel ([5, p. 35]:

> As for questions, we rely on Hamblin's dictum (1958): 'Knowing what counts as an answer is equivalent to knowing the question.' On this insight rests the whole of our erotetic logic.

Cf., also [28, p. 719].

observed earlier (see section 3), are more in the line with the pragmatic approach. Here, one might say, questions are tied to the (desired) effect: they describe the epistemic situation that results after the questioner has updated with the answer. This is quite clear from the logical structure that is assigned to questions: e.g., 'Does John come to the party' is analyzed as 'Bring it about that I know whether John comes to the party', which can be further reduced to 'Bring it about that either I know that John comes to the party or that I know that John does not come to the party'.[52]

As we remarked, an important issue that arises from the logical point of view, concerns *expressive power*: Can all questions be expressed in the language? Can all answers to a question be formulated? These issues sometimes are discussed with respect to a particular type of data-structure. In that case they are primarily design features. On a more abstract level results such as the following are obtained. Using the familiar diagonalization technique, a simple argument shows that if questions are identified with sets of formulae, being their answers, then, given some plausible assumptions concerning the number of formulae, there are more questions than can be expressed in the language.[53]

Classification, of both questions and answers, is another major concern. How do types of questions differ? What kinds of answers does a question allow? And then the relationships between these various (sub)notions have to be characterized. As for the classification of questions, here logical properties typically take priority over linguistic issues. A primary concern is always to isolate those types of questions which can be formalized, i.e., to characterize 'clear' questions which ask for some definite piece of information, and which have an answer that can be calculated, at least in principle. Again, this may differ with the kind of domain that one has in mind. Thus from a logical point of view, such interrogatives as 'Who is that man living next door?' stand in need of further analysis, because it is unclear what particular type of characterization one is asking for. With regard to answers, the distinction that is most commonly made, is that between complete and precise answers, which provide precisely the information an interrogative asks for, and partial and over-complete ones. A second distinction is that between nominal and real answers, where the former provide merely a verbal characterization, whereas the latter present a real identification of objects as a reply to a constituent question. Usually, the same distinction is made with respect to questions as such, explicitly distinguishing (in logical form) between a request for the one or the other type of answer. As far as the distinction is implemented in the syntax of the formal language, this is another example of a logical distinction which is not linguistically motivated: a natural language such as English does not distinguish between the two by providing

[52] Again, the parallel with the current concern with dynamic interpretation is striking. In effect, Hintikka's work on game-theoretical semantics (see, e.g., [37]; cf., also chapter 10) is one of the predecessors of this development. See also below, section 6.5.2.

[53] See [28] for a representative example of such argumentation. Notice that a similar kind of argument can be given in an intensional setting (in which it applies to propositions conceived of as sets of possible worlds). As for answers, we have seen above that already in the case of a simple predicate logical system not all answers need be expressible.

distinct syntactic structures to represent them. From the linguistic point of view, it seems more natural to account for the difference either semantically, by assigning two distinct readings, or pragmatically, explaining it in terms of different goals and intentions.

Presuppositions of questions also receive a surprising amount of attention in erotetic logic, surprising, because as far as indicatives are concerned, logical analyses of presupposition are mainly inspired by empirical linguistic phenomena, and not by purely logical considerations. In the analysis of Belnap & Steel ([5]) the meaning of an interrogative is more or less identified with its presuppositions, and also in the analysis developed by Hintikka ([35, 36]) they are essential ingredients. Roughly speaking, the presupposition of a question is the assumption that one of its possible answers is true. For questions expressed by alternative interrogatives, such as 'Do you want coffee or do you want tea?', this amounts to the requirement that the proposition expressing the exclusive disjunction of the two alternatives is true. And for questions expressed by constituent interrogatives of the form 'Which A is/are B?' this comes down to the requirement that there is at least (or precisely) one object among the A's that is a B. From an empirical linguistic point of view, there is indeed much to say for a presuppositional analysis of alternative questions and *wh*-phrases. But from a purely logical point of view one would rather expect the reaction that, although pragmatically marked, a reply like 'None.' (or 'There are several.') is just as good an answer as any other. At least in comparable indicative cases (definite descriptions being a case in point) this is what one gets. In the end, of course, there is a 'logical' reason for reducing the meaning of an interrogative to its presupposition: the latter are of a propositional nature. In this way standard truth conditional logic and semantics can be made to apply to interrogatives.[54]

Another issue that arises has to do with *effectiveness*: here one is concerned first of all with the problem whether it is effectively decidable whether, and if so to what extent, a certain expression is an answer to a certain question. Again, one way to go about is to design a 'normal form' for answers, which is often derived from the logical form of the corresponding interrogatives. As regards effectiveness of questions, one may investigate what is the most efficient way to formulate certain queries. A simple example illustrating the latter problem is the following. Suppose we are interested in the question which objects have both the property A and the property B, i.e., which objects form the intersection of the extensions of the two. The queries 'Which A's are B's?' and 'Which B's are A's?' both formulate this question. But the 'search routines' they invoke are different, and that may be a reason for preferring one over the other. If A is a predicate with a much larger extension than B, it is, other things being equal, more efficient to search among the B's to find the A's, than the other way around.[55] Considerations such

[54] But notice that the problems which we noticed with strictly reductionistic approaches above (see section 3.6), seem to arise in this context, too.

[55] There is an interesting connection with generalized quantifier theory here (see chapter 15). It seems that, in general, knowing which A's are B's is not the same as knowing which B's are A's. But something like conservativity does hold: knowing which A's are B's is the same as knowing which A's are A's that are B's.

as these may also lead to the introduction of particular syntactic constructions to be used in formulating queries in the formal language, which do not have obvious counterparts in natural language interrogatives. An example is provided by the explicit specification of a selection size within the query, which indicates how many instances one would be satisfied with.[56]

Although perhaps not a very fashionable subject in current philosophical logic, the logical way of doing things has provided us with a wealth of insights, concepts, and, most important, with a fruitful perspective: questions and answers set against the background of exchange of information concerning some data set. Not all elements of this picture have received the same amount of attention in the work that has been done in this tradition. In particular, the dynamic aspects of the perspective that are evidently there, have been relatively ignored.

Formal semantic theories of natural language interrogatives were largely inspired by logical work (cf., above, footnote 48), but witnessed a shift in focus, which, at least initially, led to a less encompassing picture: the information exchange perspective by and large dropped from view. But with the advent of a more dynamic perspective on interpretation this is again beginning to change. Both within formal semantics as well as in cognitive science this perspective is gaining ground, and it is to be expected that some of the logical work will turn out to be quite relevant.

5.2. Computational theories

As was already noticed above, one of the striking features of logical theories of questions and answers is their often quite explicit practical motivation. Many of the problems that are dealt with have a distinct 'computational' flavor, and return in a computational setting. Within computer science, research in the area of questions and answers is closely linked to data base theory and the development of query languages. More indirectly, there is also a link with the theory of declarative programming languages, such as Prolog. A discussion of the growing literature is beyond the scope of this chapter. The reader is referred to [39] for a recent overview.

The main issues that are dealt with bear a striking resemblance to the topics mentioned above, although the perspective is somewhat different. The picture is that of a certain amount of data, structured in a data base in such a way that it lends itself to efficient storage and manipulation. The problems center around the question what is the most efficient way to extract information from the data base. Obviously, the requirements imposed by the goals of efficient storage and manipulation, can, and often are, at odds with this. We typically request information from a database using concepts which are different from those used in storing it. Thus, the design of an efficient query language often involves a translation of one mode of representation into another. Many of the theoretical questions that are asked are

[56] In natural language, it seems that the 'extremes', viz., mention-one and mention-all (see below), are typically formulated in the interrogative form, whereas, a selection specification such as 'an odd number between 8 and 24', would rather be incorporated in an imperative structure.

related to this issue. A typical problem is that of the definability of new queries in terms of old ones, and, of paramount importance in this setting, an investigation of the complexity of this task.[57] The simplest operators defining new queries are those or relational algebras (suitably formulated). This stays within first-order logic. But also, one typically wants to compute queries which involve transitive closures of predicates, or other inductively defined constructions. This requires query languages which extend first-order logic with fixed point operators. Finally, given the nature of the task, questions of expressive power and computation are usually studied over finite data bases. This gives this account of questions the special flavor of 'finite model theory', which blends general semantic argumentation with combinatorial arguments over finite structures. Interestingly, a restriction to finite models has also been proposed independently in natural language semantics, e.g., in the theory of generalized quantifiers (see chapter 15). The problem of giving an inductive definition of a certain set of semantic objects, too, reappears in natural language semantics, e.g., in the context of quantification over properties and functions, where on the one hand we do not want quantification to run over all objects of that type, but we also do not want to restrict it to, say, the set of objects which are lexicalized. Rather, one wants the domain to consist of the set of those functions which can be defined in terms of certain closure operations over the lexicalized ones.[58]

Quite similar questions arise in the context of declarative programming languages. Such languages can also be considered as 'query' languages: a typical Prolog program resolves a question concerning some data structure. One of the relevant issues here concerns, again, definability: which definitions are 'save', i.e., lead to computationally tractable formalisms. Also other aspects are studied, such as that of finding an 'informative' formulation of the answer that the execution of a program provides

It is interesting to note, finally, that some of the mathematical tools that are used in this research, viz., those of relational algebra, are also used in another setting in which information exchange is the topic, viz., that of dynamic logic (see chapter 10). On the other hand, it is a moot point whether iteration and recursion occur in natural language the way they do in computation. Examples would be not so much explicit expressions denoting recursive procedures, but rather higher computational mechanisms, such as are involved in domain selection, anaphora resolution, or maintenance of discourse scheduling.

The research in these computational settings, although akin in spirit to the earlier logical work, has rapidly grown into a subject of its own. One subject area needs to be mentioned, in which logical, linguistic, and computational questions come together again. This area is devoted to the design of natural language query systems, in which 'translation' plays a role at several points.[59] First of all, a natural language

[57] A typical result regarding the latter is the following. It is known that a first order query in a fixed, finite model can be resolved in polynomial time. In 1974, Fagin (see [16]) proved that the reverse holds, almost: any polynomially resolvable query in a finite model can be expressed in a first order language to which a limited resource of second order concepts is added.

[58] See [21, § 4] for a concrete example of a discussion revolving around this issue in a linguistic setting, viz., that of an account of so-called 'functional' readings.

[59] A good, although not very recent example is the system described in [49].

interrogative has to be mapped onto an expression in some query language, which then has to be matched against a data base. Then the reverse problem has to be solved. Given the information extracted from the data base a formal expression has to be defined which answers the query. And this expression in its turn has to be translated in some natural language expression which serves as an answer to the original interrogative. If, furthermore, the fact that the questioner already has information at her disposal is taken into account, this task displays almost all aspects of questions and answers that are studied in logical, computational, and linguistic frameworks. Thus, despite the differences in outlook and techniques, it seems that to a large extent the undertaking is a common one, i.e., one in which in the end all involved may benefit from the results of the others.

6. Linguistic theories

In this section we first provide a brief overview of the main semantic approaches in the linguistic literature. As will become apparent, such theories share certain features, but differ at other points to such an extent that they become real alternatives. Next, we sketch some empirical data that play a key role in the shaping of these alternatives, and outline how they lead to certain choices. As it will turn out, there may be good reasons for wanting to take a liberal point of view, and not succumb to the temptation to declare one of the alternatives as the only right theory. An outline of how such a more flexible approach can be incorporated in a grammar, is given. Then we complete our survey with a sketch of some other empirical issues, and with a brief outline of recent developments.

6.1. Overview

Most linguistic theories focus on the analysis of interrogative structures as such, and the analysis of answers comes into play only in the light of that. Consequently, hardly any attention is paid to matters which we saw are of paramount importance to logical and computational theories, such as expressibility of queries and of answers. The function of interrogatives and answers in information exchange is acknowledged but most of the time it is deferred to pragmatics and it does not influence the semantic analysis as such. Of prime importance for these linguistic approaches is 'to get the facts right', and that is taken to consist in giving an account of typical ambiguities that interrogatives display, their presuppositions, their behavior under embedding verbs, and so. And it is primarily in terms of their predictions on these matters that they are compared.

All semantic linguistic theories share a basic conviction, viz., that the semantic object that an interrogative expresses has to provide an account of the answers that the interrogative allows. That is, they all accept the third of Hamblin's postulates given above (§ 4.1). But they diverge as to their acceptance of the other two postulates. Thus, according to some, answers are of all kinds of linguistic categories,

hence they reject Hamblin's first postulate, which says that answers have a sentential, or propositional character. Others accept it, but hold that interrogatives admit of more than one true answer, which means that they reject the second postulate, which states that answers are exhaustive and mutually exclusive. And then there are theories which accept all three.

6.1.1. Partition theories

Let us start with the latter, since they fit in with the kind of account we sketched above as the 'Hamblin picture'. As we saw above, the Hamblin-picture gives us a clean and coherent view of questions and answerhood. It presents us with a uniform and formally appealing notion of a question as a partition of a logical space of possibilities. It ties questions in a natural fashion to answers, the latter being the blocks of the partition. And it is able to account for equivalence of interrogatives and entailments between them in a standard way, i.e., without appealing to definitions of these notions which are specific for this kind of expressions. And to some extent, it is able to account for coordination of interrogatives in a likewise general fashion.

Partition theories have been developed by Higginbotham & May (see [34, 33]), and Groenendijk & Stokhof (see [20, 21]). The Higginbotham & May approach starts from the basic point of view expounded above, that a question corresponds to 'a partition of the possible states of nature', such a partition representing 'the suspension of judgment among a set of mutually exclusive and jointly exhaustive alternatives' ([34, p. 42]). Their analysis concentrates on the derivation of interrogatives with more than one occurrence of a *wh*-phrase, such as 'Which man saw which woman?' and 'Which people bought which books?'. The details of their analysis are rather complicated, since they want to take into account what they consider to be semantic presuppositions of *wh*-phrases, in particular the uniqueness presupposition of singular *wh*-phrases. A straightforward implementation thereof wrongly predicts that 'John saw Mary and Bill saw Sue' violates the presuppositions of 'Which man saw which woman?'. In fact, Higginbotham & May argue, the uniqueness presupposition for such structures amounts to the requirement that there be a bijection between two subsets of the domains of the *wh*-phrases.[60] The derivation of such bijective interpretations, it is claimed, cannot proceed in a step-by-step fashion, introducing and interpreting one *wh*-phrase at a time, i.e., considering it as an ordinary unary quantifier. Given the uniqueness presupposition associated with a singular *wh*-phrase such a procedure would result in a reading of, e.g., 'Which man saw which woman?' in which it would presuppose that only one man saw only one woman. For single, i.e., one constituent, *wh*-interrogatives this is the right reading, and for some multiple *wh*-interrogatives it may also be the only reading available (cf., footnote 60). But in general this 'singular' interpretation is too strict. Derivation of the bijective interpretation, Higginbotham & May claim, requires the introduction of a binary (generally, n-ary) *WH*-operator, of which arbitrary argu-

[60] According to Higginbotham & May, there are structures in which this reading is not available, viz., those in which the domains of the two *wh*-phrases are not disjoint. An example would be 'Which number divides which number?, asked of a single list of numbers.

ments may be marked for uniqueness. This operator is of the following general form:

$$WH_n^K(x_1 \ldots x_n)$$

where K is a set of integers k such that $k \leq n$. When applied to a sentence of the form $\phi(x_1 \ldots x_n)$ the result is a partition with each argument x_k with $k \in K$ being interpreted uniquely. Arguments not so marked correspond to occurrences of plural *wh*-phrases, which lack the uniqueness presupposition. Thus, the representation of 'Which man saw which woman?' on the bijective reading would be the following:

$$[WH_2^{\{1,2\}} x, y\colon \texttt{man}(x) \wedge \texttt{woman}(y)]x \ \texttt{saw} \ y$$

A representation of 'Which man saw which women?', with a plural second argument, would have $WH_2^{\{1\}} x, y$ instead. One interesting thing about this analysis is that this way of deriving multiple *wh*-interrogatives seems an instance of a general quantificational mechanism, viz., that of *polyadic quantification* (see [7] and chapter 15; cf., also section 4.5). In fact, in the original paper, Higginbotham & May argue that similar mechanisms provide an account of the phenomenon of crossing coreference (as in Bach-Peters sentences such as 'Every pilot who shot at it hit a Mig that chased him'.) This is just one case which shows that there are interesting parallels between the analysis of *wh*-interrogatives and that of other quantifying expressions, which one would want a general theory of quantification to account for.

The partition approach of Groenendijk & Stokhof differs from that of Higginbotham & May in that it does not incorporate uniqueness presuppositions into the semantics of *wh*-phrases. They derive interrogatives from what are called 'abstracts', which express n-place relations. The semantic rule reads as follows:[61]

$$\lambda w \lambda w'(\lambda x_1 \ldots x_n(\phi(w', x_1, \ldots, x_n)) = \lambda x_1 \ldots x_n(\phi(w, x_1, \ldots, x_n)))$$

This rule defines a partition based on an n-place relation by grouping together those worlds in which the relation has the same extension.[62] In other words, it defines an equivalence relation on the set of worlds, which holds between two worlds iff the extension of the relation in question is the same in those worlds. An ordinary indicative sentence is taken to express a 0-place relation, i.e., a proposition. Hence this rule also derives questions expressed by sentential interrogatives, i.e., bipartitions.

Both approaches make (roughly) the same predictions with respect to answerhood. In particular, they are committed to what is called 'strong exhaustiveness'. This aspect will be discussed more extensively below.

[61] In what follows we use two-sorted type theory as a representation language. Two sorted-type theory is like the familiar intensional type theory of Montague (see chapter 1), but allows explicit reference to and quantification over worlds.

[62] Cf., definition 4.15 above.

6.1.2. Sets of propositions theories

According to the partition view an interrogative denotes its true and complete answer. In other words, its denotation is a proposition, and its sense a function from worlds to such propositions. Hence, the meaning of an interrogative is an entity of type $\langle s, \langle s, t\rangle\rangle$.[63] Other approaches take a different view: they hold that the denotation of an interrogative is a *set* of propositions, and its sense a function from worlds to such sets. Thus, they assign a different type of object to an interrogative as its meaning, viz., one of type $\langle s, \langle\langle s, t\rangle, t\rangle\rangle$.

Not all theories that assign this type of object to an interrogative interpret it in the same way, and hence they differ in what objects they actually associate with a given interrogative. For example, according to Hamblin ([27]), the set of propositions denoted by an interrogative consists of its *possible* answers, whereas Karttunen ([40]) lets its consist of its *true* answers. Thus a simple interrogative of the form 'Who will be coming to dinner tonight?' on the Karttunen analysis will denote in a world w the set consisting of those propositions which are true in w and which state of some person that (s)he is coming to dinner tonight:[64]

$$\lambda p(\exists x(p = \lambda w(\texttt{come-to-dinner}(w)(x))) \wedge p(w))$$

The propositions which make up this set each state of some individual which actually is coming to dinner that he/she is coming to dinner. On Hamblin's analysis the restriction to individuals that are actually coming to dinner is dropped.[65] Notice that in both cases the propositions are mutually compatible, which marks a principled difference with the partition theories.[66] Exactly how the individual propositions are related to answers is not entirely clear. Hamblin describes them as 'those propositions that count as answers' ([27, p. 46]), and Karttunen looks upon them as propositions which 'jointly constitute a true and complete answer' ([40], p. 20). In connection with this, it is important to note that in Karttunen's analysis the various denotations of an interrogative are also mutually compatible. This means that if we interpret the Karttunen sets as Karttunen himself suggests, the answers which his analysis defines for an interrogative are mutually compatible, too. This marks a difference with partition theories. Whereas the latter subscribe to strong exhaustiveness, Karttunen only acknowledges weak exhaustiveness. More on this below.

The main difference between Hamblin's and Karttunen's approach, which is probably the most influential analysis in the semantics literature to date, is that the former concentrates on stand alone interrogatives, whereas the latter is concerned mainly with embedded interrogatives. It is from their behavior in various embed-

[63] Where s is the type of possible worlds, t that of truth values. See chapter 1 for more details.

[64] Application ($p(w)$) of a propositional expression (p) to a world denoting expression (w) expresses that the propositional expression is true in that world.

[65] The Hamblin set of propositions can be regained from the Karttunen interpretation simply by collecting all denotations. Likewise, a Karttunen set can be distinguished within the Hamblin set by selecting those elements which are true in a particular possible world. In this respect the difference between the two is not very essential.

[66] So Hamblin's analysis should not be confused with the Hamblin-picture!

ding contexts that Karttunen derives arguments in favor of his modification of Hamblin's original proposal (although he adds that he considers none of them as a 'knock-down argument' ([40, p. 10])). For example, Karttunen observes that in a sentence such as 'Who is elected depends on who is running' it are the true answers (in various worlds) to the respective interrogatives that are involved, not just their possible ones.

Like on the Higginbotham & May approach, interrogatives on Karttunen's analysis are the result of what basically is a quantificational process. Roughly, Karttunen defines a base level of what he calls 'proto-questions', derived from indicatives ϕ, which are of the form:[67]

$$\lambda p(p = \lambda w(\phi) \wedge p(w))$$

Wh-phrases are regarded as existentially quantified terms. A quantificational process like that of Montague's quantifying-in then derives interrogatives from indicatives containing a free pronoun, using their proto-question interpretation. Multiple constituent interrogatives are derived in a step-by-step fashion.

Two things need to be noticed. First of all, unlike Higginbotham & May, but like Groenendijk & Stokhof, Karttunen does not build any existential and/or uniqueness presuppositions into the semantics of interrogatives. Secondly, his use of a quantificational analysis in combination with the level of proto-questions results in what are called 'de re' readings of constituent interrogatives. Cf.:

$$\lambda p(\exists x(\texttt{student}(w)(x) \wedge p = \lambda w(\texttt{come-to-dinner}(w)(x))) \wedge p(w))$$

This is Karttunen's translation of 'Which student passed the exam?'. Notice that the restrictor CN of a *wh*-phrases is outside the scope of the proposition. Thus such a proposition claims *of* a student that he/she comes, but not (also) that he/she is a student. More on this below.

Interestingly, the Hamblin and Karttunen analyses are not the only ones in which an interrogative is taken to denote a set of propositions. On the analysis developed by Belnap (in [4]) and Bennett (see [6]) interrogatives are assigned the same type of semantic object, but with a radically different interpretation: each proposition in the set is assumed to express a complete true answer. Hence, unlike in the Karttunen and Hamblin interpretation, the elements of the denotation of an interrogative are mutually exclusive. Accordingly, an interrogative such as 'Which student passed the exam?' will denote a singleton set. Why, then, the complication of assigning them *sets* of propositions? In this way Bennett and Belnap aim to account for interrogatives which have more than one complete true answer. Examples of such interrogatives will be discussed below.

We end with noting the following characteristics of these sets of propositions theories, regarding entailment and coordination. Let us start with the Karttunen

[67] In two-sorted type theory every context-dependent expression has an occurrence of a variable w, ranging over worlds.

analysis.[68] The standard definition of entailment in terms of inclusion predicts no entailment of 'Is Bill coming to dinner? by 'Who is coming to dinner?'. As an immediate consequence we note that 'John knows who is coming to dinner' does not imply 'John knows whether Bill is coming to dinner'.[69] This is related to the matter of exhaustiveness, to which we return shortly. As for coordination, it is easy to see that a standard conjunction rule, which amounts to taking the intersection of two denotations, does not make adequate predictions in certain cases. For example, given that John and Mary are different individuals, the intersection of

$$\lambda p(\exists x(p = \lambda w \texttt{love}(w)(j, x))) \wedge p(w))$$

which is the denotation of 'Whom does John love?', with:

$$\lambda p(\exists x(p = \lambda w \texttt{love}(w)(m, x))) \wedge p(w))$$

which is denoted by 'Whom does Mary love?, is empty, predicting that 'Whom do John and Mary love?' (on the conjunctive reading) does not have an answer.

As for the Bennett and Belnap approach, similar observations can be made. It, too, does not do well with regard to entailment and conjunction. It does, however, make the right predictions concerning disjunction. We return to this shortly.

6.1.3. Categorial theories

A final landmark in the landscape of semantic approaches is provided by so-called 'categorial theories'. Examples of categorial approaches can be found in in work of Hausser and Zaefferer, Tichy, and Scha (see [29, 30, 51, 49]).

Categorial theories do analyze interrogatives in terms of answers, but do not start from the assumption that the latter represent a uniform type of object. Rather, it is noted that answers are not always sentences, but may be of all kinds of categories. Also, it is observed that different kinds of interrogatives require different kinds of non-sentential answers, also called 'constituent answers'. Categorial theories focus on the relation between interrogatives and constituent answers. The existence of a categorial match between interrogatives and their characteristic constituent answers is taken to determine their category. The categorial definition of interrogatives is chosen in such a way that in combination with the category of its constituent answers, the category of indicative sentences results. Again, there is some lee-way here. Hausser, for example, takes an interrogative to be of a functional category, viz., that function which takes the category of its characteristic answers into the category of sentences. Tichy prefers to identify the category of an interrogative with that of its characteristic answers.

As a result, different kinds of interrogatives are of distinct categories and semantic types. One of the consequences of this lack of a uniform interpretation of

[68] The following applies, *mutatis mutandis*, also to the Hamblin analysis.

[69] Given that Karttunen requires the subject to know every proposition in the denotation of the embedded interrogative (or, in case the denotation is empty, the proposition that it is empty). See [31] for discussion and an alternative that is meant to remedy the shortcoming noted in the text.

interrogatives is that entailment relations between interrogatives of different categories cannot be accounted for by means of the standard notion of entailment, since the latter requires such interrogatives to be of the same type. More generally, since categorial theories focus on the linguistic answerhood relation, constituted by categorial fit, a semantic notion of answerhood as a relation between propositions and questions remains outside their scope.

6.2. Key data

Up to now we have given short characterizations of various kinds of semantic theories, without going into the details of their motivation. But, surely, it must be possible to given reasons for preferring one type of approach over another? In what follows we want to discuss this matter a little further, by discussing some crucial empirical data that can be, and sometime have been, adduced in favor of certain theories. But we must warn the reader at the outset: we are not presenting the motivations as the various proponents have given them, but discuss the matter in a systematic fashion. We know that in doing so we distort history, but we hope that the picture of the field that emerges is clear.

The starting point of our discussion will be the Hamblin-picture, i.e., that view on the semantics of interrogatives that subscribes to each of Hamblin's three postulates. As we shall see, corresponding to each of these three postulates empirical data can be adduced that provide some reason to question it. But before turning to three of them, we must point out a phenomenon that seems to lie beyond the reach of the Hamblin-approach as such.

6.2.1. Open questions

It is clear that the Hamblin-picture makes certain choices with regard to, and hence imposes certain restrictions on, its subject matter. A major one is the following. The notion of a question that the Hamblin-picture accounts for is one where the possible answers are pre-set, so to speak. The alternatives are 'already given'. In other words, giving an answer to a question is regarded as making a choice from a set of alternatives which are determined by the question itself. (In this respect there is an interesting resemblance with multiple-choice questionnaires.) This follows more or less straightforwardly from the third postulate, viz., that to know the meaning of a question is to know what counts as an answer to it. Questions such as these may be called 'informative questions'. However, if one takes informative questions as a point of departure, the picture one arrives at, does not seem to apply, at least not in a straightforward way, to so-called 'open questions', which are not requests for a particular piece of information. The question addressed in this chapter, viz., the one expressed by the interrogative 'What are questions?', is probably a good example. It seems reasonable to assume that both the authors and the reader understand this question, i.e., are able to grasp the meaning of the interrogative, without there being a number of pre-set possible answers which are determined by the question itself.

In this respect open questions differ from those expressed by such interrogatives as 'Who will be coming to dinner tonight?', where, depending on the domain, the set of possible answers is clear in advance ('Harry, Jane and Bill.'; 'Just Bill and Suzy.'; 'Nobody.'; and so on). Answering an open question is a creative process, one might say, where we make up the answers as we go along, and do not simply choose from a pre-established set. Notice that another distinctive feature of open questions seems to be that with them it often seems to make little sense to ask whether or not a particular answer to such a question is true or false. Rather, answers are qualified as good or bad, as more or less comprehensive, or helpful, and so on. Thus, it seems that open questions do not satisfy two assumptions which, as was observed above, are inherent features of the Hamblin-picture, viz., the Existence and Uniqueness Assumptions concerning answers. One might say that in the case of open questions answers do not already exist, but have to be created, and that there is no unique answer to be created, but that there is an unlimited amount of not necessarily mutually inconsistent answers that can be given. So open questions do not fit the picture. Or rather, the picture does not fit them.

It seems fair to conclude that Hamblin's picture (which, to be sure, was presented by Hamblin as a proposal for a certain *methodology*) is restricted to one, albeit an important, type of questions, viz., informative questions. Whether or not this methodology is a sound one depends on whether or not open questions really are conceptually different from informative ones, a matter which has not been really settled in the literature to date. As a matter of fact, we may observe that almost all analyses are limited in that they confine themselves to informative questions.

The considerations concerning the distinction between 'open' and 'informative' questions point towards an 'external' limitation of the Hamblin-picture, suggesting that, if the observations made above are correct, it needs to be supplemented by an analysis of a different kind of questions. Other considerations, however, aim at the heart of the picture itself, purporting to show that it fails to do justice to the properties of the kind of questions it was designed to deal with, viz., informative ones. Thus it can be argued that the Hamblin-picture rests on assumptions concerning answerhood which are empirically inadequate. One assumption in particular has been attacked, for a variety of reasons, and that is the Unique Answer Assumption, i.e., the assumption that in a situation an interrogative has a unique true and complete answer.[70] In effect, many of the alternative theories that have been proposed can be understood (systematically, that is, not historically) as attempts to do without this assumption.

[70] Note that the assumption itself can be misunderstood in a variety of ways. Although questions in the Hamblin-picture have a unique true and complete answer (if their presuppositions are fulfilled), there are still many ways in which they can be answered (truly). The notions of complete and partial answerhood discussed above illustrate this fact. Furthermore, if we take the pragmatics of question-answering into account, the range of potential answers that the theory allows for is virtually unlimited (see [22, 23] for some discussion). At the same time it brings order in this chaos by making it possible to define clearly which propositions, given particular circumstances concerning the information of the speech participants, count as optimal answers.

6.2.2. Exhaustiveness

Before turning to a brief discussion of some phenomena that can be adduced to argue that the Unique Answer Assumption is not warranted, we first mention briefly some observations that seem to support it. These observations concern certain equivalences between interrogatives that seem to be needed to get an account of the validity of certain arguments.[71] Thus, it seems that from 'John knows who is coming to dinner tonight' it follows that 'John knows whether Mary is coming to dinner tonight'. Also, it seems that, assuming that the domain is fixed over John's epistemic alternatives, i.e., that it is known to John of which individuals the domain consists, it follows from 'John knows who is coming to dinner tonight' that 'John knows who is not coming to dinner tonight'. To account for the validity of this type of inference, it seems we need the equivalence, under the assumption stated, of course, of interrogatives of the form $?xPx$ and $?x\neg Px$, and also entailment between $?xPx$ and $?Pa$.[72] Hamblin's picture delivers these goods.

This feature is often discussed under the heading of 'exhaustiveness'. Usually, a distinction is made between 'weak' and 'strong' exhaustiveness. By the former we understand the requirement that a complete answer specify all true single 'instances', i.e., that it exhaustively specify the range of true partial answers. Strong exhaustiveness requires in addition a closure condition: that the answer not only in fact *give* such an exhaustive specification, but also in addition *state* that it is exhaustive. Thus, a weakly exhaustive answer provides a complete list, a strongly exhaustive answer contains in addition the closure condition stating 'and that's all, folks'. Strong exhaustiveness, thus, should not be confused with the requirement that an answer specify both the positive and the negative extension of a relation.[73] Partition theories as such are committed to strong exhaustiveness in the proper sense, but not to the latter requirement. In fact, as we saw above, the latter requirement is empirically unjustified: the equivalence of interrogatives of the form $?xPx$ and $?x\neg Px$ holds only if we assume that the domain from which the instances are drawn is fixed.[74] A phenomenon that has been suggested to constitute a counterexample to strong exhaustiveness is that of 'quantificational variability', involving adverbs of quantification, such as 'mostly', 'rarely'. See below, section 6.4.3.

It is of some interest to note that the phenomenon of exhaustive interpretation is not restricted to interrogatives and answers. Within the semantics of plural NPs, some (see, e.g., [32]) have suggested that we need a 'minimal', i.e., exhaustive, interpretation of the generalized quantifiers such NPs express. Also, in the theory of topic and focus, exhaustiveness plays an important role. See, e.g., [11]. In fact, as many authors have suggested, there may be an intimate relationship between questions

[71] Cf., [20] for more elaborate discussion.

[72] Another observation which supports this requirement is the following. We are discussing which of our friends are coming to dinner tonight. Suppose that Mary and Suzy are in fact coming to dinner tonight, but John erroneously believes that Mary, Suzy, and Bill will come. Then it seems wrong to attribute to John knowledge of who is coming to dinner.

[73] This misinterpretation has caused a lot of confusion in the literature. For discussion of these issues see [25].

[74] Cf., also fact 4.18, (iv), in section 4.5.

and answers, and topic and focus. See [42] for systematic discussion. Rooth (see [47]) provides a detailed account of the relationship between Karttunen's analysis of questions and his theory of focus, which is based on 'alternative semantics'.

Moreover, the idea of exhaustiveness seems natural, not just from a strictly linguistic point of view, but also in a wider cognitive setting. In various kinds of theories which deal with information exchange and with reasoning on the basis of partial information, we can trace the idea that informational 'moves', as a rule, are to be interpreted exhaustively. That is, information is treated in a non-monotone way, i.e., it is interpreted as giving *all* information (concerning the topic in question), unless stated otherwise.[75] This ties in with the natural assumption that information exchange is structured by an 'underlying' pattern of questions and answers (cf., the relationship with topic and focus structure referred to above, see also [45]). In effect, many specific features of discourse structure (both monological and dialogical) seem to depend on this.

But let us now turn to some observations that can be adduced to argue against the Unique Answer assumption, also in order to get a better grip on the various semantic theories that have been proposed in the literature.

6.2.3. Mention-some interpretation

The following observation constitutes an internal criticism of the Hamblin-picture. It seems that in some situations, obviously informative interrogatives do have several, mutually compatible and equally adequate answers. Consider the following example: A tourist stops you on the street and asks 'Where can I buy an Italian newspaper?'. Clearly, she does not want you to provide her with a complete specification of all the places where Italian newspapers are sold. All she wants is that you mention *some* such place. Thus, both 'At the Central Railway Station.' and 'At the Athenaeum bookstore.' (and a host of others) each are in and of themselves complete answers, and they are mutually compatible.

Such an interpretation is often called the 'mention-some' interpretation of an interrogative, since the answers mention *some* object that satisfies the condition expressed by the interrogative. Per contrast, the interpretation that the Hamblin-picture accounts for is referred to as the 'mention-all' interpretation, since its answers specify *all* such objects. Notice that, although the subject matter of the example we gave strongly suggests a mention-some interpretation, it does not exclude a mention-all interpretation. Thus we may imagine that the interrogative is used by someone who is interested in setting up a distribution network for foreign newspapers. Clearly, such a person would use the interrogative on its mention-all interpretation, since he would regard only a list of all stores selling Italian newspapers as a complete answer.[76]

[75] See chapter 6, and [8].

[76] There is, again, an interesting parallel with other instances of quantification, this time concerning 'donkey sentences'. Here, too, there are cases of structures for which a 'universal' interpretation seems to be preferred ('If Pedro owns a donkey, he beats it' seems to entail that Pedro beats all the donkeys he owns), whereas other instances which exhibit the same pattern, superficially at

The important question that needs to be settled in order to be able to evaluate the relevance of mention-some interpretations for the Hamblin-picture is whether they constitute a distinct reading of interrogatives, or can be accounted for along other lines. To start with the latter option, one might be tempted to think that the distinction is of a pragmatic nature: circumstantial facts (concerning intentions and interests of the questioner, for example) determine whether she is satisfied with something 'less' than the complete answer that is determined semantically by the interrogative. This in effect comes down to the view that, semantically speaking, mention-some answers are not complete answers, but function so only from a pragmatic point of view. Semantically, such answer are partial, rather than complete answers: they exclude some possibilities, but do not provide an exhaustive specification. This line of reasoning, however, is difficult to maintain for the following reason. Partial answers as defined by the mention-all interpretation may also be 'negative'. For example, 'Not at the Bijenkorf.' is a partial answer to our example interrogative on its mention-all interpretation, since it excludes certain possible answers. However, such 'negative' partial answers are no good when we take the interrogative on its mention-some interpretation, since it does not mention-some positive instance, which is what, on the mention-some interpretation, is what is required.

This suggests that mention-some interpretations really are a distinct semantic reading. If we accept this conclusion, we face the following question: does the distinction between mention-all and mention-some interpretations constitute a genuine ambiguity of interrogatives? Or can the mention-all interpretation be derived from the mention-some interpretation? Or is there an underlying semantic object from which both are to be derived? Various answers can be found in the literature. Hintikka, for example, analyzes mention-all and mention-some interpretations in terms of an ambiguity of *wh*-phrases (see [35, 36]). Groenendijk & Stokhof (with some hesitation, see [22]) turn it into a structural ambiguity. According to Belnap's analysis in [4], mention-some interpretations are on a par with so-called choice interpretations, to be discussed below.[77] Various analyses in the line of Karttunen (see [40]) can be regarded as presenting the second kind of solution. To the third option we return below.

As we saw above, on the Karttunen approach the meaning of an interrogative is a function from worlds to such sets. So, whereas a partition in the Hamblin-picture determines a single proposition, the Karttunen interpretation delivers a set of propositions as the denotation of an interrogative in a particular world. Both analyses relate questions to answers, but in a different way, and we may interpret this as a difference in what basic answers are.[78] According to the third postulate

least, prefer an 'existential' reading ('If I have a dime, I put it in the parking meter' does not require me to put all my dimes in the meter).

[77] This identification cannot be maintained, however, for reasons discussed in [22], where an alternative analysis is given.

[78] Notice that we refer to 'the Karttunen approach, and not to 'Karttunen'. We do so deliberately. The point we want to make is a systematic one, and it is not intended as a reconstruction of Karttunen's actual motivation. In fact, given that Karttunen himself described the set of propositions

of the Hamblin-picture answers are mutually exclusive and together exhaustive. In other words, in each world a question has exactly one true answer. On this interpretation of the Karttunen approach, answers are mutually compatible: there may be many propositions in a given world that are a true answer. Thus, whereas the Hamblin-picture seems eminently suited to deal with mention-all interpretations, the Karttunen approach might seem to provide a good basis for dealing with mention-some interpretations. For, the propositions which make up the denotation of an interrogative in a world, each mention some object which satisfies the condition from which the interrogative was built.

The idea that suggests itself then is to regard the Karttunen semantics as the basic one, i.e., to assume that mention-some interpretations are fundamental, and to try to obtain the mention-all interpretation from it, by defining the partition in terms of the equivalence relation of having the same set of answers. However, for various reasons this strategy does not work.

First of all, it can be observed that the phenomenon of mention-some interpretations is a particular instance of something more general: mention-n interpretation. Thus, an interrogative such as 'Where do two unicorns live?' has as one of its interpretations the one in which it asks for a specification of two distinct places where one (or more) unicorns can be found. Such an interpretation can be derived from the set of propositions that the Karttunen analysis provides, by introducing an operation that tells how many of the propositions will make up an answer.[79] But that means that it is not the Karttunen set that is the denotation of an interrogative, but a more basic semantic entity.

Secondly, as Heim has argued (see [31]) it does not seem possible to actually derive the right partition interpretation from the Karttunen set. The reasons behind this are complicated, and perhaps not entirely understood. One issue is that no account of 'de dicto' readings of *wh*-interrogatives can be obtained in this way, it seems.

Thus the resulting picture is rather complicated. And it becomes even more so if we look at another phenomenon that challenges the Unique Answer Assumption, viz., that of so-called 'choice' interpretations.

6.2.4. Choice-interpretation

One obvious instance in which the Unique Answer Assumption fails, is with respect to interrogatives which have a so-called 'choice'-interpretation. Prominent examples are provided by disjunctions of interrogatives, such as 'Where is your father? Or where is your mother?'. This interrogative does *not* ask for a specification of a place where your father or your mother (or, perhaps both) can be found. Rather, its purpose is to find out about the whereabouts of either your father or your mother. Thus, it has two mutually compatible, true and complete answers. Another example of an interrogative exhibiting this kind of interpretation is 'Where do two unicorns live?', which, besides the 'mention-two' interpretation referred to above, also has an

denoted by an interrogative as 'jointly constituting a true and complete answer' we may as well take him to present the mention-all interpretation, weakly exhaustified.

[79] See [5] for some relevant discussion of 'completeness' of questions and answers.

interpretation where it asks to specify of two unicorns where they live. Thus they are typically answered by indicatives of the form 'Bel lives in the wood, and Nap lives near the lake.'[80]

Disjunctions of interrogatives are not adequately accounted for in the Hamblin-picture, at least not by application of a generalized rule of disjunction. In the case of partitions, application of such a rule would amount to taking the pairwise union of the elements of two partitions, which, in general, does not result in a partition at all. The Karttunen approach, too, fails on this score. The Bennett and Belnap analysis, on the other hand, obviously is able to account for disjunction (but fails on conjunction).

A little reflection shows that all this may not be a coincidence. In general, application of a generalized rule of coordination to two objects of a certain type results in a new object of the same type. In the case of conjunction of questions we would indeed expect the result to be a new question. But in the case of disjunction this is, perhaps, not so obvious. Consider again the example 'Where is your father? Or where is your mother?'. As was remarked above, this interrogative has two mutually compatible, true and complete answers. But in this case it seems that this is due to the fact that the interrogative expresses two distinct questions, and not just one. Thus, in using such an interrogative, the questioner in effect expresses two questions, leaving the questionee the choice which of the two she wants to answer. Something similar can be said about the choice reading of the other example, 'Where do two unicorns live?'. The use of this interrogative amounts to the following: pick any two unicorns—the choice is yours—and answer for each of them the question where it lives. Thus this interrogative, too, does not express a single question, but two. Unlike the disjunctive example, it does not explicitly identify which two questions, but rather leaves the questionee the choice, within certain limits it sets.

What moral can be drawn from this? First of all, it seems that choice interpretations are no straightforward counterexample to the Unique Answer Assumption: if an interrogative on such an interpretation expresses more than one question, it seems we can acknowledge that it has more than more complete and true answer, while still holding on to the assumption. And actually, if we consider a slightly different example, 'What do two unicorns eat?', it seems that what we are dealing with here are two questions, each with a plausible mention-all interpretation, and thus each with a unique complete and true answer.

Secondly, the existence of this kind of interpretation, and the failure of a straightforward analysis in terms of a generalized coordination rule, indicates that interrogatives have to be analyzed at yet another level. One way to account for these interpretations is by application of a general strategy, familiar from the semantics of quantified NPs. Thus one may analyze disjunctions of interrogatives, and analogously choice interpretations, in terms of generalized quantifiers over questions, using standard coordination rules in combination with rules for lifting semantic

[80] Belnap was the first to discuss these kinds of examples, and to stress their importance for the semantics of interrogatives. See [4] for elaborate discussion.

objects.[81] An alternative analysis is the one developed by Belnap (in [4]) and Bennett (see [6]). They give up the Unique Answer Assumption (which Belnap refers to as the 'Unique Answer Fallacy') and let interrogatives denote sets of propositions, each of which constitutes a complete and true answer. Their analysis accounts for choice readings and disjunctions, but runs into problems when dealing with interpretations on which interrogatives do have a unique answer. Thus they fail to deal with conjunctions in a standard way, and also are unable to account for the entailments and equivalences which we saw the Hamblin-picture delivers.

All in all, the picture that emerges is rather varied. As we saw above, the Hamblin postulates lead to elegant and simple theories, which are capable of dealing with a range of interrogatives in a uniform way. However, such analyses also show an inherent bias towards a certain type of interpretation, the mention-all interpretation, and have problems accounting for mention-some interpretations of interrogatives. Alternative theories of the Karttunen-Hamblin type, which assign sets of propositions to interrogatives, are evidently better suited to cope with the latter, but are not able to deal with various entailments and equivalences that seem crucial for an account of a variety of phenomena, at least not in a straightforward way. The existence of choice-interpretations complicates the picture even more. Here, one of the alternatives that can be found in the literature is to add another level of analysis, viz., that of generalized quantifiers over partitions. That, however, may not be the end of the matter. In the next section we will discuss a range of phenomena that point towards yet another level on which interrogatives, it seems, must be analyzed.

6.2.5. Constituent answers

Starting point is the observation, already alluded to earlier on, that interrogatives may be answered not just by full sentences, but also by subsentential expressions, the so-called 'constituent answers'. Thus 'Who did John invite?' can be answered by 'John invited Peter and Mary', but also by 'Peter and Mary.' And a reply to 'Where are you going?' can be a full sentence, 'I am going to Amherst', but also a subsentential phrase: 'To Amherst.' Moreover, it seems that constituent answers are more closely tied to interrogatives than full sentential ones. Thus, 'John kissed Mary' can be an answer both to 'Whom did John kiss?' and to 'Why is Bill upset?'.[82] But 'Mary.' answers only the first, not the second.

Observations such as these have led to the development of the 'categorial approach' on interrogatives discussed above. According to the categorial view, interrogatives belong to a wide range of different categories, which correspond systematically to that of their characteristic linguistic answers. Thus, this approach is more syntax-oriented, and takes its lead from the surface syntactic properties of interrogatives and linguistic expressions that serve as answers. It is a theory that rejects

[81] See [24] for an analysis along these lines.

[82] But notice that in each case the spoken sentence will carry a different intonation contour. This provides yet another ground for believing that there is an intimate relationship between questions and answers, topic and focus, and intonation, something which has been noticed by a number of authors. See the references given earlier.

the first of the three Hamblin postulates, which says that answers are sentences, or statements.

In view of that, one might be tempted, at first sight, to brush this approach aside, precisely because it is too syntactically oriented, and semantically deficient. The first Hamblin-postulate, one may reason, is beyond doubt: answers express propositions, or proposition-like objects anyway, since answers convey information. This much must be granted, it seems, but there is one aspect of the categorial view that indicates that it can not simply be disregarded. This has to do with the derivation of mention-all interpretations. Consider the sentence 'John invited Mary.' Assuming a mention-all interpretation, this sentence conveys different information if it answers different interrogatives. As an answer to 'Whom did John invite?' it states that Mary is the one (the only one) that John invited. But when it is a reply to 'Who invited Mary? it means that John was the one (again, the only one) who invited Mary. These are different propositions, which shows that in some way the proposition expressed by a sentential answer depends on the meaning of the interrogative. One way to account for that is by taking the different constituent answers, in this case 'Mary.' and 'John.' respectively, as starting point of the derivation of this single sentential answers, thus in effect treating it as ambiguous.[83] In effect this shows that also within the confines of a propositional theory the categorial viewpoint has a certain role to play, and that hence there is yet another level at which interrogatives need to be analyzed, viz., that of n-place relations.

6.3. A flexible approach?

Summing up, we see that various semantic theories analyze interrogative structures at various levels: as n-place relations, as (functions from possible worlds) to sets of (true) propositions, as partitions of a space of possibilities, and also at the level of generalized quantifiers over such entities. This is a confusing multitude of semantic objects. However, for each of these theories some empirical and methodological motivation can be given, as the foregoing survey has shown. This suggests that perhaps the search for one single type of object which is to function as the semantic interpretation of interrogatives is misguided by an unwarranted urge for uniformity. It might well be that in some contexts (linguistic or otherwise) the meaning of an interrogative must be taken to consist of one type of object, and in other contexts it should be looked upon as being of another type. What a proper semantic theory should do then is not to look for one type of object, but to define a multitude of types and to establish systematic relationships between them.

In fact, this situation occurs not just with the analysis of interrogatives: it appears to be a justified methodology in other areas of linguistic description as well. The analysis of referring expressions, names, quantified NPs, descriptions, is a clear case in point. Here, too, it seems that we need to analyze such expressions at various type-levels, and to define adequate type-shifting rules which capture the

[83] See [23] for an analysis along these lines.

connections. Thus, the apparently confusing multitude observed above turns out to be another instance of a familiar pattern. Flexible approaches to category/type assignment, and the associated systems of category/type shifting rules have been the subject of extensive study, especially in the context of categorial syntax with the associated type-theoretical semantics (see chapter ??).

One of the rules needed in the analysis of interrogatives on this account we have already met above. It is the rule which turns an n-place relation into a partition. A similar rule that would deliver a Karttunen style set of propositions is easy to formulate as well. (It would differ from Karttunen's actual analysis by not proceeding in a step-by-step fashion.) Further, we need the 'Montague rule', which turns an entity of a certain type into that of a generalized quantifier over entities of that type, to account for disjunction and related phenomena. We also observed above that, apparently, no rule can be stated which transforms a Karttunen set into a partition in the Groenendijk & Stokhof style, the reason being that the latter assign de dicto readings, whereas the former provide de re specifications. And we may need yet other rules as well, to deal with other phenomena.

To what extent the various rules form a 'coherent' set, is an relatively unexplored issue. Some initial work has been done in [24], but many questions remain open. Yet, the emerging picture certainly seems attractive, shedding as it does the rigid 'one category – one type' attitude that has dominated semantics for quite some time. The 'polymorphic stance' has proved useful in other areas as well.

6.4. Other empirical issues

Above we have discussed mention-all, mention-some, choice interpretations of interrogatives, constituent answers, and the various 'pictures' that they give rise to, in some detail. In what follows we will very briefly mention some other empirical issues and provide pointers to relevant literature.

6.4.1. Functional interpretations

Some interrogatives exhibit what is often called a 'functional' interpretation. An example is given by the following sequence: 'Whom does every Englishman admire most?' 'His mother.' Here the answer does not specify an individual, but a function that delivers such an individual for each entity specified by the subject term of the interrogative. These interrogatives are also interesting because they exhibit unusual binding patters: thus, in 'Which of his relatives does every man love?' the subject term 'every man' binds the variable 'his' which is inside the *wh*-phrase 'which of his relatives'. Functional interpretations are discussed in [15, 21, 13].

Functional interpretations are not restricted to interrogatives. For example, a indicative such as 'There is a woman whom every Englishman admires', has a reading on which it can be continued by specifying, not an individual, as in: 'The Queen Mother', but a function: 'His mother'. This is a separate reading, which is also to be distinguished from the reading in which the subject NP has wide scope.

(Compare 'There is a woman whom no Englishman admires' with 'No Englishman admires a woman'.) This provides yet another indication that quantification in indicative and interrogative structures exhibit quite similar patterns.

6.4.2. Pair-list interpretations

Yet another type of interpretation is the so-called 'pair-list' interpretation. Consider 'Which student did each professor recommend?'. This interrogative can be interpreted as asking for a specification of those students that got a recommendation of every professor. On this (mention-all) interpretation it is typically answered by providing a list of individuals: 'John, Mary, and Suzy.' But there is also another interpretation, on which the interrogative asks to specify for each professor which student(s) (s)he recommended. A typical answer for this readings gives a list of professor-student pairs (hence the name): 'Professor Jones recommended Bill and Harry; Professor Williams recommended Suzy and John; ...'. Notice that these answers are like those of a two-constituent interrogative. In fact, its has been argued that on its pair-list reading 'Which student did each professor recommend?' is equivalent with 'Which student did which professor recommend?'.[84]

Pair-list readings are often connected with the phenomenon of quantifying into interrogatives. See for example [6, 4]. But if the above observation concerning the relation with two-constituent interrogatives is correct, a pair-list reading can not be the result of quantification of the subject NP into an interrogative. For one thing, such an analysis would not account for the 'two-constituent' nature of the answers. And it would give the subject NP a de re reading, whereas the two-constituent interrogative reads both *wh*-phrases de dicto. For argumentation along these lines, see [22].

An extensive discussion, also of other phenomena in which quantifiers and questions interact, can be found in [13], where the patterns exhibited by this interaction are related to Weak Crossover, and it is argued that pair-list readings are a special case of functional readings.

6.4.3. Quantificational variability

Another phenomenon that has been related to quantification into interrogative structures is that of 'quantificational variability'. An example is provided by the following sentence: 'The principal mostly found out which students cheated on the final exam'. The main importance of these structures seems to be their role in the ongoing debate on exhaustiveness. According to some (see, for example, [9]) they provide a counterexample: if the quantification is over students, then the principal finds about the majority of the students who cheat that they do, but she need not find out about all of them, and neither does she have to find out about all students that don't cheat that they don't.

This has been challenged (see, for example, [31, 43, 19]) on various grounds. Most opponents feel that in such structures the adverb quantifies, not over individuals,

[84] Barring, perhaps, differences having to do with salience.

but events, or 'cases'. Also, an attempt has been made to show how quantificational variability can be made to accord with strong exhaustiveness (see [25]).

6.4.4. Embedding verbs

Another important set of phenomena that up to now we almost have passed over in silence concerns the classification of various types of embedding verbs. This was already a major topic in Karttunen's pioneering analysis ([40]), and has been subject of further study by several authors (see, e.g., [43, 18]). We just mention here a few issues that have received attention.

First of all, observe that not all verbs take both indicative and interrogative complements: *know*, *tell*, *guess*, for example, take both; a verb such as *believe* combines only with indicative complements; and *wonder*, *investigate*, and the like, are restricted to interrogative complements. Furthermore, note that verbs which take both, also take 'hybrid' coordinations, as in 'John knows/revealed/guessed who left early and that Mary was disappointed'. This suggests strongly that in both the interrogative and the indicative context it is one and the same relation that is at stake, which makes an account in terms of lexical ambiguity implausible. Another interesting phenomenon has to do with factivity properties of embedding verbs. Some verbs which take both interrogative and indicative complements are factive with respect to both: 'John knows that Bill comes to dinner' implies that Bill comes to dinner, and, likewise, 'John knows whether Bill comes to dinner' implies that John knows the *true* answer to this question. Other verbs behave differently, however. Thus, whereas 'John tells whether Bill comes to dinner does imply that John tells the true answer, it does not follow from 'John tells that Bill comes to dinner' that Bill in fact comes to dinner.

Such facts need to be explained. One way to account for the factivity phenomenon is to let interrogatives denote their true answer(s), and to distinguish between 'extensional' and 'intensional' verbs, i.e., verbs which operate on the extension of the interrogative complement, and verbs which take its intension. Thus, *know*, *tell* would take a (true!) proposition as their argument, viz., the one denotated by the question, whereas *wonder*, *investigate* take the question as such. See [20].

A further refinement has recently been proposed by Ginzburg (see [18]), who suggests to replace the three-fold distinction just mentioned by a four-fold one: factive predicates (*know*), nonfactive resolutive predicates (*tell*), question predicates (*wonder*), and truth/falsity predicates (*believe*). The first category takes both interrogative and indicative complements, and semantically operates on propositions. The fourth category only combines with indicative complements, and operates on an individual type of entity, related to, but different from propositions. This is corroborated by the observation that such verbs also take nominal complements ('John believes the prediction Bill made'). The third category takes only interrogative complements, which express questions. Finally, elements of the second category have both indicative and interrogative complements, the latter again taken to express an individual type of entity, which is different from a question, but related to it. Ginzburg's analysis has obvious ontological ramifications, which by him are

spelled out in a situation-theoretic framework, but which presumably can also be implemented in a property-theoretic setting.

6.4.5. Presuppositions

The question whether and, if so, which presuppositions are associated with interrogatives, or with *wh*-phrases has already been alluded to earlier on. We noticed that in the logical analyses of Belnap & Steel ([5]) and Hintikka ([35, 36]) presuppositions are essential ingredients. They provide the means for individuating (classes of) questions. In Hintikka's approach the presupposition of a question is involved in spelling out its desideratum. Thus, alternative questions ('Is John in London, or in Paris?') are said to presuppose the truth of (exactly) one of the alternatives. Constituent interrogatives ('Who is coming to dinner?') are assumed to have existential presuppositions, viz., that there is at least one instance satisfying the predicate. In more linguistically oriented analyses, the discussion tends to focus on the uniqueness presupposition which is supposed to distinguish between singular and plural *wh*-phrases. The analysis of Higginbotham & May ([34]) is a case in point. In the case of interrogatives, presupposition failure is usually said to result in the interrogative lacking a (true) answer. Other authors, e.g., Karttunen ([40]), have been more indifferent.

As is the case with presuppositions of indicatives, discussion of these issues is complicated by the fact that one of the most important questions, viz., whether these presuppositions are a semantic or rather a pragmatic phenomenon, is underdetermined by our 'pre-theoretic' intuitions. Some authors distinguish negative answers from rejections ('mere replies'), but one may well wonder to what extent such distinctions are theory-loaded. Keeping this in mind, the following observations[85] may still serve to place the claim that these are straightforward semantic presuppositions in a wider perspective.

Let us start with existential presuppositions. It seems that, at least with the *wh*-phrase *who*, clear cases are actually hard to find. Of course, an interrogative such as 'Who is that?' has an existential presupposition, but it seems due to the demonstrative rather than to the *wh*-phrase. Next, consider a case such as 'Who is coming with me?'. There may be an expectation on part of the questioner that there is someone coming with her, but it does not seem to be a presupposition. For it seems that 'Nobody.' is a perfectly straight (albeit perhaps disappointing) answer, and not a rejection of the question as such.

Uniqueness presuppositions do not seem to fare much better. Consider again 'Who is coming with me?'. Does this presuppose that not more than one person is coming along, and that hence 'John and Bill.' is not an answer? It seems not. This is not to deny that expectations of uniqueness do not occur. But they seem not strictly tied to singular *wh*-phrases as the following example shows. Consider the following two pairs of interrogatives: 'Which member of the cabinet voted against the proposal?' – 'Which members of the cabinet voted against the proposal?'; and 'Which

[85] Taken from [21].

member of the cabinet leaked the information to the press?' – 'Which member of the cabinet leaked the information to the press?'. The association of uniqueness seems opposite in both cases. In the first pair the plural seems neutral as regards the number of people involved, whereas in the second pair it is the singular that is neutral, and the plural is marked. An explanation can be found, it seems, by taking into account the nature of the activities involved: leaking information is typically an individual activity, whereas voting against is something one (often) does along with others. Hence, the expectations concerning (non-)uniqueness which are associated with the interrogative seem to depend (primarily) on other material than the *wh*-phrases used.

6.5. Extending the scope

The survey of theories and phenomena given in the previous sections has touched upon the main approaches and results that can be found in the literature to date, though not upon every one of them in the same detail. Thus it has provided a survey of the main stream of theorizing in this area. In what follows we want to indicate, again only briefly, what we think are two important directions for current and future research.

Whatever their differences all semantic theories considered above share certain characteristics, which are currently being challenged. One is that the semantics of interrogatives is considered from a relatively context-independent point of view. This must not be misunderstood: what we mean is not that the semantic objects assigned to interrogatives are context-independent, on the contrary. Rather, what we want to draw attention to is that it is often taken for granted that the semantic objects as such can be assigned in a relatively context-independent way. Consequently, semantic objects associated with interrogatives are in most cases total objects. Another feature that characterizes almost all existing semantic analyses is the essentially static nature of the semantics they assign to interrogatives, a feature that is no doubt connected with the frameworks in which these analyses are formulated.

Recently, semantics has witnessed a move towards more context-dependent and dynamic models of meaning. This development has occurred not just in natural language semantics, where it is connected with situation theory, discourse representation theory, and dynamic semantics, but also in more logically and computationally oriented research. From these developments a new view on meaning and interpretation is emerging, in which context, in particular the epistemic context, and context change are key notions. As such, it would seem to provide a framework that is eminently suited for an analysis of interrogatives.

6.5.1. Context-dependency and partiality

In a series of papers (see[18, 19]) Ginzburg has developed a theory which differs from main stream semantical theories in a rather fundamental way. Ginzburg, who

formulates his approach in the framework of situation theory, discusses several phenomena which he takes to indicate that the relation of answerhood (or, as he calls it, 'resolvedness') is a partial and highly contextual one. He charges other approaches with taking a too absolute view on this relationship. This, he claims, is not just descriptively incorrect, but also theoretically unsound.

The phenomena Ginzburg discusses have to do with several aspects of the question–answer relationship. One of them concerns fine-grainedness. This seems to play a role in interpreting and answering such interrogatives as 'Where am I?', or in judging the truth of 'John knows where he is'. It depends, Ginzburg argues, essentially on the context (of utterance) exactly how these expressions must be interpreted. Thus the interrogative 'Where am I?' when uttered by someone stepping down from a plane at Schiphol Airport, obviously needs a different kind of answer than when it is uttered by someone stepping down from a taxi at the Dam square. For notice that, although both Schiphol Airport and the Dam square are located in Amsterdam, the answer 'In Amsterdam.' is not a good answer in the latter case, since it is not likely to resolve a lack of knowledge of the questioner. In that situation a more fine-grained set of answers is determined by interrogative and context.

Intentionality is another issue. It seems that the intentions of the questioner play a key role in determining what kind of answer is called for by an interrogative such as 'Who attended the lecture?': does it call for a specification of names, roles, or yet other aspects that 'identify' individuals? Likewise, the goals and plans of the questioner must be taken into account in answering such interrogatives as 'How do I get to Rotterdam from here?'.

According to Ginzburg the essentially context-dependent character challenges exhaustiveness, even in its weak form. These phenomena certainly constitute a major challenge for existing approaches. To what extent they can be modified to be able to deal with these issues remains open for the moment. Another issue is whether these phenomena are particular to interrogatives, or rather concern interpretation in a wider sense.

6.5.2. Dynamic interpretation

As we observed above, all mainstream semantic analyses of interrogatives are cast in a static framework. The rise of dynamically oriented frameworks in semantics raises the question whether interrogatives are perhaps better analyzed in such a dynamic setting. Several attempts have already been made to cast a semantics of interrogatives in a dynamic mould. One early attempt is the work of Hintikka, who in developing his framework of game theoretical semantics (see, e.g., [37]) has also paid attention to dynamic aspects of the meaning of interrogatives. This seems quite natural: in the game between 'I' and 'Nature' questions have a clear function, viz., that of steering the game by determining sets of moves.[86] Hintikka has also used questions to implement a distinction in the epistemic setting as such, viz., that

[86] There is also an obvious connection with dialogue semantics here.

between information which is deduced from given data, and information which is obtained by asking questions and getting them answered. These types of information play a distinct role. In fact, the imperative-epistemic approach as such has a distinct dynamic flavor, although the frameworks used, those of imperative and epistemic logic, are not explicitly concerned with information change. More indirectly, dynamic aspects have been dealt with in work that is concerned with information exchange in discourse structured by question–answer patterns (see, e.g., [45]). Also the work on pragmatic notions of answerhood (see [23]) must be mentioned here. Catching on to more recent developments, Zeevat ([53]) combines the Groenendijk & Stokhof semantics with Veltman's update semantics (see chapter 10).

There are several interesting empirical and methodological issues that arise here. First of all, the connection with topic–focus structures, and the relation with certain principles of discourse organization have to be explored systematically. These issues have been discussed by several authors, as we have noticed above, but not in a systematic fashion. Another topic concerns anaphoric chains across utterances, where questions seem to license more than assertions ('A man is walking in the park.' 'Does he wear a black hat?'). Also, a dynamic framework, in which information exchange is the key notion, seems to provide a natural surrounding for an account of exhaustiveness, which may be tied up with non-monotonicity of information exchange.

All in all, it seems that extending the scope of semantic theories of interrogatives, giving due attention to their context-dependent character and analyzing them in a dynamic framework, holds much promise. For interrogatives are the structures in natural language par excellence which are concerned with information and information (ex)change. To be sure, the neat distinction between semantics and pragmatics that has enabled the semantics of interrogative structures to develop into a field of its own, thereby becomes more subtle, perhaps even blurred. But that should not blind us to the reality of the intimate relationships that exist between meaning and use.

*

Thus, it may seem that we have come full circle, returning to where we started from, viz., the pragmatic approach. But appearances are deceiving here. For in traveling this far, we do have established the possibility of a semantics of interrogatives, as a field of its own. And extending its scope is not revoking its articles of faith.

References

[1] J. L. Austin, *How to Do Things With Words*, Oxford: Oxford University Press, 1962

[2] Rainer Bäuerle & Thomas Ede Zimmermann, 'Fragesätze', in: Arnim von Stechow & Dieter Wunderlich (eds), *Semantik/Semantics: An International Handbook of Contemporary Research*, Berlin: de Gruyter, 1991, pp. 333–48

[3] Nuel D. Belnap jr., 'Approaches to the Semantics of Questions in Natural Language. Part I', Pittsburgh, 1981
[4] Nuel D. Belnap jr., 'Questions and Answers in Montague Grammar', in: S. Peters & E. Saarinen (eds), *Processes, Beliefs, and Questions*, Dordrecht: Reidel, 1982, pp. 165–98
[5] Nuel D. Belnap jr. & Thomas B. Steel jr., *The Logic of Questions and Answers*, New Haven: Yale University Press, 1976
[6] Michael Bennett, *Questions in Montague Grammar*, Bloomington: IULC, 1979
[7] Johan van Benthem, 'Polyadic Quantification', *Linguistics and Philosophy*, **12**, 1989, pp. 437–64
[8] Johan van Benthem, 'Semantic Parallels in Natural Language and Computation', in: H.D. Ebbinghaus et. al. (eds), *Logic Colloquium. Granada 1987*, Amsterdam: North-Holland, 1989, pp. 331–75
[9] Stephen Berman, *On the Semantics and Logical Form of Wh-Clauses*, dissertation, Amherst, 1991
[10] Stephen Boër and William Lycan, *Knowing Who*, Cambridge, Mass.: MIT Press, 1985
[11] Andrea Bonomi & Paolo Casalengo, '*Only*: Association with Focus in Event Semantics', *Natural Language Semantics*, **2**, 1993, pp. 1–45
[12] Max Cresswell, *Logics and Languages*, London: Methuen, 1973
[13] Gennaro Chierchia, 'Questions with Quantifiers', *Natural Language Semantics*, **1**, 1992-3, pp. 181-234
[14] Urs Egli & Hubert Schleichert, 'Bibliography of the Theory of Questions and Answers', in: Nuel D. Belnap jr. & Thomas B. Steel jr., *The Logic of Questions and Answers*, New Haven: Yale University Press, 1976
[15] Elisabet Engdahl, *Constituent Questions*, Dordrecht: Reidel, 1986
[16] Ronald Fagin, 'Generalized first-order spectra and polynomial-time recognizable sets', in: R. M. Karp (ed), *Complexity of Computation*, SIAM–AMS Proceedings, **7**, 1974, pp. 43–73
[17] Gottlob Frege, 'Der Gedanke', *Beiträge zur Philosophie des deutschen Idealismus*, **1**, 1918 [English translation in: Peter Geach & Max Black, *Translations from the Philosophical Writings of Gottlob Frege*, Oxford: Blackwell, 1960]
[18] Jonathan Ginzburg, 'Resolving Questions I & II', *Linguistics and Philosophy*, **18**, 1995, pp. 459–527, 567-609
[19] Jonathan Ginzburg, 'Interrogatives: Questions, Facts and Dialogue', in: Shalom Lappin (ed), *Handbook of Contemporary Semantic Theory*, Oxford: Blackwell, 1995, pp. 385–422
[20] Jeroen Groenendijk & Martin Stokhof, 'Semantic Analysis of *Wh*-Complements', in: *Linguistics and Philosophy*, **5**, 1982, pp. 175–233
[21] Jeroen Groenendijk & Martin Stokhof, 'Interrogative Quantifiers and Skolem-functions', in: Konrad Ehlich & Henk van Riemsdijk (eds), *Connectedness in Sentence, Discourse, and Text*, Tilburg: Tilburg University Press, 1983
[22] Jeroen Groenendijk & Martin Stokhof, *Studies on the Semantics of Questions and the Pragmatics of Answers*, dissertation, Amsterdam, 1984
[23] Jeroen Groenendijk & Martin Stokhof, 'On the Semantic of Questions and the Pragmatics of Answers', in: Fred Landman & Frank Veltman (eds), *Varieties of Formal Semantics*, Dordrecht: Foris, 1984, pp. 143–70
[24] Jeroen Groenendijk & Martin Stokhof, 'Type-Shifting Rules and the Semantics of Interrogatives', in: Gennaro Chierchia, Ray Turner & Barbara Partee (eds), *Properties, Types and Meaning. Vol. 2: Semantic Issues*, Dordrecht: Kluwer, 1989, pp. 21–68
[25] Jeroen Groenendijk & Martin Stokhof, 'Interrogatives and Adverbs of Quantification', in: Katalin Bimbó & András Máté (eds), *Proceedings of the Fourth Symposium on Logic and Language*, Budapest: Áron Publishers, 1993, pp. 1–29
[26] C. L. Hamblin, 'Questions', *Australasian Journal of Philosophy*, **36**, 1958, pp. 159–68
[27] C. L. Hamblin, 'Questions in Montague English', *Foundations of Language*, **10**, 1973, pp. 41–53
[28] David Harrah, 'The Logic of Questions', in: Dov Gabbay & Franz Guenthner (eds), *Handbook*

of Philosophical Logic. Vol. II., Dordrecht: Kluwer, 1984, pp. 715–64

[29] Roland Hausser, 'The Syntax and Semantics of English Mood', in: Ferenc Kiefer (ed), *Questions and Answers*, Dordrecht: Reidel, 1983, pp. 97–158

[30] Roland Hausser & Dietmar Zaefferer, 'Questions and Answers in a Context-Dependent Montague Grammar', in: Franz Guenthner & S. J. Schmidt (eds), *Formal Semantics and Pragmatics for Natural Languages*, Dordrecht: Reidel, 1978, pp. 339–58

[31] Irene Heim, 'Interrogative Complements of 'Know", in: Rhonna Buchalla & Anita Mittwoch (eds), *The Proceedings of the Ninth Annual Conference and the workshop on Discourse of the Israeli Association for Theoretical Linguistics*, Jerusalem: Academon, 1994, pp. 128–44

[32] Herman Hendriks, 'Generalized Generalized Quantifiers in Natural Natural Language', Amsterdam: ILLC, 1988

[33] James Higginbotham, 'The Semantics of Questions', in: Shalom Lappin (ed), *Handbook of Contemporary Semantic Theory*, Oxford: Blackwell, 1995, pp. 361–84

[34] James Higginbotham & Robert May, 'Questions, Quantifiers, and Crossing', *Linguistic Review*, **1**, 1981, pp. 41–79

[35] Jaakko Hintikka, 'The Semantics of Questions and The Questions of Semantics', *Acta Philosophica Fennica*, **28**, 1976

[36] Jaakko Hintikka, 'New Foundations for a Theory of Questions and Answers', in: Ferenc Kiefer (ed), *Questions and Answers*, Dordrecht: Reidel, 1983, pp. 159–90

[37] Jaakko Hintikka, *The Game of Language*, Dordrecht: Reidel, 1983

[38] Jaakko Hintikka & Merryl Hintikka, *The Logic of Epistemology and the Epistemology of Logic*, Dordrecht: Kluwer, 1989

[39] P. Kanellakis, 'Elements of Relational Database Theory', in: Jan van Leeuwen (ed), *Handbook of Theoretical Computer Science*, Amsterdam: Elsevier, 1990, pp. 1073–1156

[40] Lauri Karttunen, 'Syntax and Semantics of Questions', *Linguistics and Philosophy*, **1**,1977, pp. 3–44

[41] Lauri Karttunen & Stanley Peters, 'Interrogative Quantifiers', in: Christian Rohrer (ed) *Time, Tense, and Quantifiers*, Tübingen: Niemeyer Verlag, 1980, pp. 181–206

[42] Jan van Kuppevelt, *Topic en Comment*, dissertation, Nijmegen, 1991

[43] Utpal Lahiri, *Embedded Interrogatives and the Predicates that Embed Them*, dissertation, MIT, 1991

[44] David Lewis, 'General Semantics', *Synthese*, **22**, 1970, pp. 18–67

[45] Rolf Mayer, 'The Release of Information in Discourse: Compactness, Compression, and Relevance', *Journal of Semantics*, **7**, 1990, pp. 175–219

[46] Mary Prior & Arthur Prior, 'Erotetic Logic', *Philosophical Review*, **64**, 1955, pp. 43–59

[47] Mats Rooth, 'A Theory of Focus Interpretation', *Natural language Semantics*, **1**, 1992, pp. 75–116

[48] John Searle, *Speech Acts*, Cambridge: Cambridge University Press, 1969

[49] Remko Scha, *Logical Foundations for Question Answering*, dissertation, Groningen, 1983

[50] Erik Stenius, 'Mood and Language Game', in: *Synthese*, **17**, 1967, pp. 254–74

[51] Pavel Tichy, 'Questions, Answers, and Logic', in: *American Philosophical Quarterly*, **15**, 1978, pp. 275–84

[52] Daniël Vanderveeken, *Meaning and Speech Acts*, two volumes, Cambridge: Cambridge University Press, 1990

[53] Henk Zeevat, 'Applying an Exhaustivity Operator in Update Semantics', in: Hand Kamp (ed), *Ellipsis, tense, and Questions*, Amsterdam: ILLC (DYANA-deliverable R2.2.B), 1994, pp. 233–69

[54] Lennart Åqvist, *A New Approach to the Logical Theory of Interrogatives*, Uppsala, 1965

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Worksheet - Word order in questions with do/does

Put the words into the correct columns and form questions. Always use the auxiliary do or does.

How to work with the table

- Underline all verbs in the following lines ***(sentence 1: like)*** and write these words into the column **Verbs**.
- Look for the subject of the sentence ***(sentence 1: you)*** and write it into the column **Subject**.
- Then write ***do*** or ***does*** into the column **Auxiliary** (use does with he - she - it; use do with I, you, we, they) ***(sentence 1: do -> because of you)***.
- Then write the question word into the first column (if there is none, write ---) ***(sentence 1: no question word, write ---)***.
- Write all the remaining words into the column **Object - Place - Time *(sentence 1: English)***.

1) like / you / English
2) play / he / football
3) read / they / books
4) when / go / the boys / to school
5) why / you / smoke
6) check / teacher / your homework
7) Bill / when / get up / in the morning
8) drink / you / milk
9) where / your father / live
10) what / sell / Max
11) your mother / do / the shopping
12) when / we / meet
13) why / in front of the school / they /wait
14) computer games / play / Fred
15) the Robinsons / how / live
16) Andrew / have / what hobbies
17) rain / it / a lot in England
18) like / which picture / best / you
19) a cup of coffee / the girls / in the morning / have
20) who / Doris / phone

	Question word	***Auxiliary***	***Subject***	***Verb***	***Object - Place - Time***
1	---	Do	you	like	English?
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					

Simple Present (interrogative)

1. Write questions as in the example.

1. *You / speak English.* *Do you speak English?*
2. She / work hard.
3. They / have dinner at eight
4. Jill and Tom / study at university
5. You / do your homework every day
6. John / watch TV after dinner.
7. He / wash the car at the weekend.
8. Her friends / live in London.
9. You / have any brothers or sisters.
10. Your friends / go to the cinema very often.

2. Complete the questions with *do* or *does*.

1. ..... she take her gog for a walk in the morning?
2. ..... your friend Paul work in the shop over there?
3. ..... they know the answers to the exam?
4. ..... your parents know that you smoke?
5. ..... Bill teach maths?
6. Where ..... your sister live?
7. What time ..... the lessons finish?
8. ..... you go to the coast in summer?
9. ..... it rain very often in Ireland?
10. Why ..... they ask so many questions in class?

3. Write short answers to these questions (yes, I do / no, I don´t / yes, she does / no, she doesn´t, ...)

1. Do you speak French? .....
2. Does your mother like chocolate? .....
3. Do you study a lot? .....
4. Do you usually watch TV at night? .....
5. Do you play a musical instrument? .....
6. Does your father work? .....
7. Do you go to the cinema? .....
8. Does your best friend study? .....
9. Does it rain a lot in Africa? .....
10. Do you live in a flat? .....

Answers

Exercise 1:

2. Does she work hard?
3. Do they have dinner at eight?
4. Do Jill and Tom study at university?
5. Do you do your homework every day?
6. Does John watch TV after dinner?
7. Does he wash the car at the weekend?
8. Do her friends live in London?
9. Do you have any brothers or sisters?
10. Do your friends go to the cinema very often?

Exercise 2:

1. Does she take her gog for a walk in the morning?
2. Does your friend Paul work in the shop over there?
3. Do they know the answers to the exam?
4. Do your parents know that you smoke?
5. Does Bill teach maths?
6. Where does your sister live?
7. What time do the lessons finish?
8. Do you go to the coast in summer?
9. Does it rain very often in Ireland?
10. Why do they ask so many questions in class?

Exercise 3:

1. Yes, I do / No, I don´t
2. Yes, she does / no, she doesn´t
3. Yes, I do / No, I don´t
4. Yes, I do / No, I don´t
5. Yes, I do / No, I don´t
6. Yes, he does / No, he doesn´t
7. Yes, I do / No, I don´t
8. Yes, she/he does // No, she/he doesn´t
9. Yes, it does / No, it doesn´t.
10. Yes, I do / No, I don´t