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The View from Building 20

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in Honor of Sylvain
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edited by

Kenneth Hale and
Samuel Jay Keyser

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1 Introduction

It is a pleasure to be able to present this paper as part of a volume to honor Sylvain Bromberger. My subject, interrogative sentences and the questions that they express, is one on which he has thought and written deeply and at length. I am specifically indebted to Sylvain for discussion in our seminar from some time back, and for many conversations over the years. Above all, however, I am grateful to him for his support early on of my hybrid research into language and philosophy, and I hope he may think that this work justifies it at least in part.

In this paper I advance some parts of a view of interrogative sentences and their interpretations, with reference to English examples. The details of this view depend upon assumptions about the semantics of embedded indicative sentences that I use but do not defend here. I therefore distinguish at the beginning the major theses I advance about interrogatives, which I would urge even apart from these assumptions, from others that will show up in the details of execution. The major theses are these:

1. The semantics of interrogative sentences is given by associating with them certain objects, which I will call *abstract questions*; I will say that the interrogative *expresses* an abstract question. To utter the interrogative is to ask the abstract question that it expresses.
2. Pairs of *direct* questions, as in (1), and their corresponding *indirect* questions, as in the italicized complement of (2), are related in this way: the direct question expresses what the indirect question refers to.

(1) Is it raining?

(2) John knows *whether it is raining*.

3. Indirect questions are singular terms, and they occupy quantifiable places of objectual reference. Thus, for example, the argument (3) is valid.

(3) John is certain (about) whether it is raining;

Whether it is raining is Mary's favorite question; therefore,

John is certain about (the answer to) Mary's favorite question.

4. *Elementary* abstract questions (what is expressed by simple interrogatives, or referred to by simple indirect questions) are partitions of the possible states of nature into families of mutually exclusive (and possibly jointly exhaustive) alternatives. *Complex* abstract questions (the result of quantifying into interrogatives, or conjoining them, as explained below) are constructed out of elementary ones. These form a hierarchy of orders, with abstract questions of order n being sets of sets of abstract questions of order $n - 1$.

5. Abstract questions can be constructed by generalizing along any of several different semantic dimensions, and can be referred to by appropriate syntactic means even when their dimensions of generality are not domains of quantification in the indicative fragment of a language; such categories include those of predicates, quantifiers, and even parts of words. However, most abstract questions are not the reference of any interrogative sentence at all.

In sections 2–5 I present informally a number of definitions and illustrations of the point of view I advance. In section 6 I turn to a defense of theses 1 and 2. In the final section, which I have labeled an appendix because it involves more material from logic and linguistics than the others, I argue that an explanation of the licensing of negative polarity items in interrogatives can be seen to follow from the proposal I develop here and in other work.

2 Preliminary Definitions and Illustrations

An *abstract question*, what is expressed by an interrogative form, is not itself a linguistic form (although it is in a sense constructed from linguistic forms, in a way explained more fully below), but on the present view a nonempty *partition* Π of the possible states of nature into *cells* P_i for $i \in I$, having the property that no more than one cell corresponds to the true state of nature (i.e., the cells are mutually exclusive). If in addition at least one cell must correspond to the true state of nature, then Π is a *proper* partition (i.e., the cells are jointly exhaustive). The elements of a cell P_i can be thought of as statements, so that P_i corresponds to the true state of nature if and only if all the statements that it contains are true.

Partitions are used in probability theory, and I will freely adapt terminology from there. If Π is a partition, and S is a set of statements, let

$\Pi + S$ be the result of adjoining S to each P_i . Thus, if

$$\Pi = \{P_i\}_{i \in I}$$

then

$$\Pi + S = \{P'_i\}_{i \in I}$$

where, for each i ,

$$P'_i = P_i \cup S$$

Since Π is a partition, so is $\Pi + S$; but Π may be proper while $\Pi + S$ is improper.

A cell of a partition may be *satisfiable* or *unsatisfiable*. Let F be some designated unsatisfiable set, fixed throughout the discussion, for example, $F = \{p \& \neg p\}$. F is the *degenerate* set, and the improper partition $\{F\}$ is the degenerate partition. If Π is a partition, let Π^- be the result of deleting the unsatisfiable cells from Π (or $\{F\}$ if all are unsatisfiable). If S is a set of sentences, let Π/S , or the *conditionalization* of Π on S , be $(\Pi + S)^-$. Then Π/S is a partition. Also, we evidently have

$$(\Pi/S_1)/S_2 = (\Pi/S_2)/S_1 = \Pi/(S_1 \cup S_2)$$

An *answer* to a question Π is a set S of sentences that is inconsistent with one or more cells in Π . If Π is the degenerate partition $\{F\}$, then S answers Π for every S . S is a *proper* answer if it is an answer and Π/S is not $\{F\}$.

The notions introduced by the above definitions may be illustrated through a fabricated example. Let Π be a partition whose cells are statements about the possible outcomes of rolling two dice A and B , where the outcomes are distinguished according to the total shown by the dice. There are eleven cells, which will be represented by the numbers 2 through 12, each of which stands for a complex disjunctive statement giving the outcomes that would add up to those totals; thus, cell 6 is

(Die A : 1 & Die B : 5) or (Die A : 2 & Die B : 4) or ...

... or (Die A : 5 & Die B : 1)

Then Π is a partition, since the outcomes are regarded as functions of A and B , and it is proper given the background information that the values of these functions are integers between 1 and 6.

The above proper partition Π is one way of construing the question expressed by (4),

(4) What was the total of the dice?

incorporating further information about how totals in a throw of two dice may be obtained. A person who asks (4) will be said, following Belnap (1963), to have *put* the question Π .

Consider now the statements in (5) as responses to (4).

- (5) a. (The dice totaled) 12.
 b. (I don't know but) one came up 4.
 c. The sun is shining.
 d. The dice were never thrown.

In much of the literature on interrogatives, it is answers like (5a) that have been chiefly considered. Their relation to the interrogative sentence is particularly intimate: they provide *instances* of the matrix

the total of the dice was (the number) _____

instances that are also in a sense *canonical* to the type of question asked; that is, they are *numerical* instances, rather than nonnumerical instances like

the total of the dice was the number of the apostles

Objects themselves, rather than their standard names, can also be taken as filling the blank in the matrix above. Following this course, I regard the instances arising from substitution of names as *presentations* of the instances arising from assignment of the objects themselves.

In discussions including Karttunen 1977 and Hamblin 1973 the question expressed by an interrogative was simply the totality of its instances (Hamblin), or alternatively the totality of its true instances (Karttunen). The totality of instances for (4), which might be indicated by abstracting over the empty matrix position as in (6),

- (6) λx (the total of the dice was x)

is a natural candidate for the abstract question expressed by (4), and the question arises whether the further step to partitions does not create a needless complexity.

My belief is that the definition of answerhood requires the more complex structure. Besides canonical and noncanonical instances, there are answers that give only partial information, as illustrated by (5b). Partial answers give information by being inconsistent with some, but not with all but one, of the possibilities enumerated in the partition. Obviously, they must be distinguished from irrelevant remarks like (5c).

Not that (5c) is necessarily irrelevant. If it is known that the dice are crooked, loaded somehow to show double-six when the sun shines on

them, it may be just as informative as (5a). Such knowledge, and background information more generally, is appealed to in seeing that Π really is a partition (thus, the more general notion is that of a partition *relative to background B*). An answer that contravenes background conditions violates the *presuppositions* of a question, in an appropriate sense of this term.¹ Technically, if X is a presupposition of Π , then every cell of Π implies X , and so if S is inconsistent with X , then S is inconsistent with every cell of Π , so that $\Pi/S = \{F\}$. The response (5d) thus violates the presupposition of (4) that the dice were thrown.

Summing up, I have suggested that simple interrogatives express partitions (relative to background assumptions), and that complete and partial answers, nonanswers, and responses that violate presuppositions can all be appropriately characterized on that assumption.

Consider now some examples of interrogatives. The partitions corresponding to yes-no questions are the simplest possible. They have two cells, one representing the affirmative, the other the negative. The elements of these cells need not be contents, in any sense over and above that of the sentences themselves, as interpreted in the indicative part of the language. Thus, for the question *Did John see Mary?* we have the partition (7).

- (7) $\{\{John\ saw\ Mary\}, \{John\ did\ not\ see\ Mary\}\}$

(I use bars rather than commas to separate the cells of a partition.)

For a simple *wh*-question, as in (8),

- (8) Who did John see?

I assume the logical form (9).

- (9) $[WH\alpha: person(\alpha)] ? John\ saw\ \alpha$

The cells of the partition expressed by (8) run through all the possibilities for John's seeing of persons. If in contexts there are just two persons in question—say, Fred and Mary—then a typical cell is

- $\{John\ saw\ Fred, \neg (John\ saw\ Mary)\}$

representing the possibility that John saw Fred but not Mary.

The question (8) with its quantification restricted to persons must be distinguished from the question (10), involving unrestricted quantification.

- (10) Which things are such that John saw them and they are persons?

This can be seen by noting that (11) is a (partial) answer to (10), but is in response to (8) simply an irrelevant remark.

(11) Fido is not a person.

It is also seen, rather more vividly, in pairs like (12)–(13).

(12) Which men are bachelors?

(13) Which bachelors are men?

The unrestricted question corresponding to both of these examples is (14).

(14) Which things are both bachelors and men?

But of course (12) and (13) are very different.

The generalization that the quantifications *which N* must be understood as restricted, with the variable ranging over things that in fact satisfy *N*, is supported by examples like (15),

(15) Which philosophers would you be annoyed if we invited?

where we never have an interpretation that would “reconstruct” the noun within the scope of the modal, giving a meaning like that of (16).

(16) For which things *x* would you be annoyed if *x* was a philosopher and we invited *x*?

See Reinhart 1992 for similar examples.

Higginbotham and May (1981) showed how to characterize presuppositions of singularity, as in (17).

(17) Which person did John see?

An utterance of (17) in virtue of its form carries the presupposition that John saw one and only one of Fred and Mary. Its partition will carry the presupposition in question by having only two cells, one affirming that John saw Mary and not Fred, and the other that John saw Fred and not Mary. The cells for affirming that John saw both and that he saw neither will not be represented. Similar remarks hold for presuppositions that are expressed by words rather than morphologically, as in (18).

(18) Which two articles did Mary read?

Nothing prevents our asking *wh*-questions ranging over infinite domains, or domains for which we could not possibly have a singular term for every object in the range. Thus, the question expressed by (19) is perfectly in order, although we shall be powerless to give it a complete answer.

(19) Which real numbers are transcendental?

The partition expressed by this interrogative will have cells on the order of the set of all subsets of the real numbers.

Multiple questions call for more refined partitions, as in (20).

(20) Which people read which books?

The elements of the cells of these partitions will be sentences like

John read *War and Peace*.

and their negations.² The account of single and multiple *wh*-questions extends to the case where the position interrogated is not in the main clause, but in one or another embedded position or positions, as in (21).

(21) Which people did he say like to read which books?

Finally, it should be noted that many *wh*-forms incorporate prepositions or subordinating conjunctions, as *where* incorporates *at*, and is effectively equivalent to *at which place*, and *why* incorporates either *because* or *in order to*. The latter gives a simple example of interrogatives that generalize over predicate positions, so that (22), in one of its interpretations, should be taken up as in (23).

(22) Why did John go to the refrigerator?

(23) [WHF] ? John went to the refrigerator in order to *F*

Questions like (24) have long been noted ambiguous.

(24) What did everybody say?

Intuitively, (24) asks, for each person in the range of the quantifier *everybody*, what that person said. There are some syntactic limitations on expressing questions of this form.³ Our interest here, however, is quite general: what is the question expressed by an interrogative as in (25), where *Q* is a restricted quantifier, *φ* is the restriction on *Q*, and *θ* is another interrogative?

(25) [*Qv: φ*] *θ*

The answer is that the question should be composed of sets of questions, one set for each way in which the quantifier, construed as a function from pairs of extensions to truth values, gives the value *true*.⁴ A simple example like (26) will generate the basic idea.

(26) Where can I find two screwdrivers?

A person who asks (26) may mean to inquire what place is an *x* such that there are two screwdrivers at *x*. But she may also mean just to get hold of

information that will enable her to locate two screwdrivers, and in this sense of the question it arises from the interrogative (27).

(27) [Two x : screwdriver(x)] [What α : place(α)] x at α

The partition for the embedded interrogative

[What α : place(α)] x at α

is given by our previous semantics: ' x ' is simply a free variable here. Now, the numeral *two*, construed as a restricted quantifier, is such that

Two ϕ are θ

is true if and only if at least two things satisfy both ϕ and θ . So the question expressed by (27) will be the class of all classes of partitions each of which, for at least two screwdrivers a and b as values of x (and for no other objects than screwdrivers as values of x), contains the partition for the interrogatives

[What α : place(α)] a at α

[What α : place(α)] b at α

The classes of partitions I call *blocs*, and classes of them *questions of order 1*. To answer a question of order 1 is to answer every question in one of its blocs. It follows that to answer (26) is to answer both the question where a is and the question where b is, for at least two screwdrivers a and b .

The above method of quantifying into questions extends to all quantifiers, since it is completely determined by their extensional meanings. A scrutiny of actual cases shows that any quantifier that is not monotone-decreasing (in the sense of Barwise and Cooper (1981); see the discussion in section 5 below) can in principle get wide scope in an interrogative, including even the existential quantifier, as in one interpretation of (28).

(28) What does somebody here think?

Intuition suggests that a speaker of (28) would expect from whoever elects to be his respondent the answer "*I think so-and-so*"; and that any such answer would be sufficient for the question. The theory accords with this intuition, since the abstract question expressed by the interpretation of (28) shown in (29) consists of all nonempty sets of sets of abstract questions of the form in (30), where a is a person in the domain of quantification.

(29) $[\exists x] [WH\alpha] ? x$ thinks α

(30) $[WH\alpha] ? a$ thinks α

Truth-functional *and* and *or* are recruited for conjunction and disjunction of interrogatives, as in (31) and (32).

(31) Will it be nice tomorrow, and will you go on a picnic if it is?

(32) Is Mary happy or is John happy?

Their role is clarified by the analogy between connectives and quantifiers. Conjunctive interrogatives, as in (31), are obviously answered only by statements that answer both conjuncts. In the present terminology, (31) expresses a question of order 1, whose sole bloc consists of the partitions expressed by the conjuncts. Disjunctive interrogatives, as in one interpretation of (32), will have the meaning, "Choose your question, and answer it." They express questions of order 1 whose blocs consist of one or both of the partitions expressed by the disjuncts.

The more common type of disjunctive question is the *free-choice* type, exemplified by (33) in an airline setting.

(33) Would you like coffee, tea, or milk?

My view of the role of disjunction in these cases, as explained in Higginbotham 1991a, is that they represent universal quantification into a yes-no question, as in (34).

(34) $[\forall x: x = \text{coffee} \vee x = \text{tea} \vee x = \text{milk}] ?$ you would like x

Thus, the steward who asks (33) is asking for each of coffee, tea, and milk whether you would like it (subject to the understood condition that you will have at most one of these).

Finally, multiple quantification into questions is possible, and will generalize so as to produce questions of arbitrary finite order. Such questions include (35),

(35) What did everybody say to everybody?

with both quantifiers taking wide scope.

Thus far I have considered partitions and abstract questions of higher orders with respect to domains of quantification that have not been incorporated into the abstract questions themselves. Consider (8), repeated here.

(8) Who did John see?

The proper representation of the abstract question that it expresses must include the information that the property of having been seen by John is under consideration only for persons as values. Let K be the class of persons, and let $\Pi = \pi(\text{John saw } \alpha[K])$ be the partition obtained by as-

signing just the objects in K as values of α . If the abstract question expressed by (8) is to be distinguished from the extensionally equivalent one expressed by *Which rational animals did John see?*, then information about how the class of values is determined must be incorporated somehow.

We have already seen that domain restrictions cannot be represented by conjuncts within a question—for example, that (8) must be distinguished from *Which things are persons such that John saw them?* However, we could include in each cell of the abstract question expressed by (8) the information, about each thing in K , that it is a person. If $[person(\alpha)[K]]$ is the class of atomic sentences

person(a)

for $a \in K$, we can propose the partition $\Pi' = \Pi + [person(\alpha)[K]]$ as answering to (8), thus distinguishing it from extensional equivalents.

However, Π' still fails to contain the information that the class K comprises *all* persons. This further information can be added where feasible, but is not finitely representable when the restriction is to an infinite class, for instance as in (36).

(36) Which natural numbers are prime numbers?

Similarly, a set of instances constituting a complete true answer cannot always be replaced by a finite list L , together with the information that all the positive (negative) instances are to be found on L . Such is already the case for (36) since the set of prime numbers is neither finite nor cofinite.⁵

3 Indirect Questions

An *indirect question* is an interrogative sentential form used as an argument. In general, I believe no distinction except a syntactic one should be made between the sentential argument S and the nominal argument *the question S*: both are singular terms. Thus, we have both (37) and (38).

(37) I asked whether it was raining.

(38) I asked the question whether it was raining.

Now, certain verbs that take interrogative complements cannot take nominal complements; thus, (39) is ungrammatical.

(39) *I wondered the question whether it was raining.

Pesetsky (1982) observes, however, that this fact may be reduced to an issue of abstract Case (the verb *wonder* does not assign Case to its com-

plement, which therefore cannot be nominal); and that the introduction of morphemes, normally prepositions, for the purpose of assigning Case gives grammatical sentences whose meaning is just that of the corresponding sentence with a sentential complement. Thus, we have both (40) and (41).

(40) I wondered whether it was raining.

(41) I wondered about the question whether it was raining.⁶

Inversely, the verbs that take both nominal and sentential complements can appear with Noun Phrase complements whose interpretation is that of interrogatives. These are the so-called concealed questions, exemplified by (42).

(42) I asked the time (what the time was).

In all the above cases, in the view developed here, the complements refer to the abstract questions that they would refer to if used in isolation (with the necessary superficial syntactic adjustments). Thus, to ask whether p is to ask

$\{p, \neg p\}$ ⁷

With the epistemic verbs, and indeed with all verbs whose arguments are naturally taken to refer to propositions or to facts, interrogative complements are mediated by relations to answers to the abstract questions that they refer to. Thus, I assume that (43) is interpreted as in (44).

(43) Mary knows who John saw.

(44) Mary knows the (or an) answer to the question who John saw.

Berman (1989) has called attention to sentences with indirect questions in conjunction with quantificational adverbs, as in (45) and (46).

(45) Mary mostly knows who John saw.

(46) With some exceptions, Mary knows who John saw.

Examples are not limited to epistemic verbs, as (47), modeled after examples in Lahiri 1990, 1992, attests.

(47) John and Mary mostly agree on who to invite.

I look upon these adverbs (differently from Berman) as qualifying the nature of the answers said to be known, or as in the case of (47), agreed upon; for example, (47) will be true if, out of a potential guest list of 20,

John and Mary have agreed for (say) 15 on whether to invite them or not. See Lahiri 1992 for further discussion.

Finally, there are interrogative arguments to verbs that have nothing to do with acts of speech or mental states. Karttunen (1977) noted indirect questions in contexts such as (48).

(48) What will happen depends on who is elected.

Predicates like *depend on* express relations between abstract questions, and the notion of dependence at stake, applied to (48), comes to something like: Answers to the question who is elected, together with other facts, imply answers to the question what will happen. There are many other similar locutions, such as *is influenced by*, *is relevant to*, and of course their negations.

It is worth observing that (48) leaves open the exact nature of the dependency, or the ways in which who is elected will influence what happens. In the parallel and simpler example (49), it may be that rising temperature causes rain, or prevents it; and you may know (49) without knowing which it is.

(49) Whether it will rain depends on whether the temperature will rise.

4 Extensions to Higher Types

The basic apparatus developed here can be applied to construct abstract questions with respect to expressions of any syntactic category, independently of whether they occupy quantifiable places in the indicative fragment of a language. The sense in which the variables bound by *wh*-expressions have a range then dwindles toward the substitutional. For instance, interrogatives like (50) are likely to be put forth only where a fairly narrow range of linguistic alternatives is envisaged.

(50) What (profession) is John?

Even questions expressed with *which* are often best answered simply by filling in appropriate material in the site of syntactic movement. So for (19), repeated here, an answer might be as in (51).

(19) Which real numbers are transcendental?

(51) Those real numbers that are not solutions to any equation are transcendental.

Engdahl (1986) has called attention to interrogatives like (52),

(52) Which of his poems does no poet want to read?

where, understanding the pronoun as a variable bound to *no poet*, the answer might be as in (53).

(53) His earliest poems.

I accept Engdahl's view that these interrogatives likewise involve quantification over nonarguments, in this case over functions. Thus, their logical forms might be represented as in (54).

(54) [Which f : $(\forall x) f(x)$ is a poem by x] [For no poet y]
 y wants to read $f(y)$

The need for functional interpretations of this kind is not confined to questions, since it occurs also with relative clauses, and even with definite NPs, as in (55).

(55) John made a list of the dates no man should forget.

John's list might read as follows:

children's birthdays
own wedding anniversary
Independence Day
.....

The list is a list of those f whose domain is the class of men and whose range is included in the class of dates $f(x)$ such that no man x should forget $f(x)$.⁸

The recent discussion by Chierchia (1991) shows that for many purposes quantification into interrogatives can be replaced by the functional interpretation. I illustrate using the example (24), repeated here.

(24) What did everybody say?

Suppose we understand *what* as having a functional interpretation, as in Engdahl 1986, and incorporate an appropriate description of the functions over which it ranges, as in (56).

(56) [WH f : $(\forall x) x$ says $f(x)$] ? $(\forall y) y$ said $f(y)$

(56) must be allowed as possible anyway, because of possible answers to (24) such as (57).

(57) The speech she had memorized.

But now we might regard the listiform answer (58) as simply one way of specifying a desired function f .

(58) Mary said this, and Susan that, and Margaret the other.

The representation of (24) as (59) appears then to become redundant.

(59) $(\forall y) [WH\alpha] ? y \text{ said } \alpha$

There are several points that would have to be clarified before (56) and (59) could be declared equivalent. As I have defined the interpretation of (59), true and complete answers to it must exhaustively specify for each person y what y said and also what y did not say. If this view is carried over to (56), then exhaustive information about the functions f would be required to answer it, and not merely the specification of some f . On the other hand, in any context in which (58) is a complete and true answer to (59), it is a complete and true answer to (56) as well.

The logical limitations of functional interpretation surface when the exported quantifier binds a variable within a larger *wh*, as in (60).

(60) Which picture of each student should we put in the yearbook?

A complete answer to (60) might be listiform, as in (61), or involve pronouns as bound variables, as in (62).

(61) (We should put) this picture of Jones, and that picture of Smith, and . . . , and that picture of Robinson.

(62) The picture in which he is wearing a hat.

From (60) we have the representation (63).

(63) $[\forall x: \text{student}(x)] [WH\alpha: \alpha \text{ a picture of } x] ? \text{ we should put } \alpha \text{ in the yearbook}$

For a functional interpretation of (60) we can no longer apply the routine exemplified in (56), but would instead have to posit something like (64).

(64) $WHf: \text{domain}(f) = \text{the students} \ \& \ (\forall x) f(x) \text{ is a picture of } x$
 $? (\forall y) (\forall z) [y \text{ is a picture of } z \rightarrow (\text{we should put } y \text{ in the yearbook} \leftrightarrow y = f(z))]$

There are also a number of cases where listiform answers are unavailable, which nevertheless admit functional interpretation. Among these are (65) and (66).

(65) Who did President Vest shake hands with after each student introduced him to?

(66) Which of his relatives does every student really love?

Only functional answers like

His or her mother.

are appropriate for (65) and (66).⁹ On the assumption that listiform answers are salient only where there is quantification into questions, these data follow from known conditions on scope of quantifiers and pronominal binding. Thus, in (65) we do not expect to be able to assign *each student* wide scope, since it is not interpretable with wide scope in (67).

(67) President Vest shook hands with his mother after each student introduced him to her.

Taken all together, then, these problems indicate that, besides functional interpretations of *wh*, genuine quantification into questions is possible in rather basic sentences of English. And in any case there is no difficulty in constructing sentences with *explicit* quantification into questions, as in (68).

(68) I want to know for each person what that person said.

I return now to some final points about higher types for *wh*. One can sweep out positions for whole clauses (with *why*) or adverbs (with *how*) and even quantifiers, with *how many*, as in (69).

(69) How many books have you decided to read?

Note that (69) is ambiguous, having either the interpretation indicated in (70) or that in (71).

(70) $[WHQ] ? \text{ You have decided to read } [Q \text{ books}]$

(71) $[WHQ] ? [Qx: \text{book}(x)] \text{ you have decided to read } x$

All of the cases just discussed seem to fall under the theory presented here.¹⁰

5 The Presentation of Questions

The semantics of questions, as I have presented it above, abstracts completely from the ways in which the objects, or the things in ranges of higher types that are values of the interrogative variables, are given to us, or may be given to a questioner or respondent. It furthermore abstracts from the questioner's motives, if any, and other pragmatic matters. It seems to me that semantic theory, and especially the theory of truth for sentences with interrogative complements, requires this abstraction. We can raise questions that we do not know how to answer, and for which, as Bromberger (1966 and elsewhere) has pointed out, we do not even know

what an answer would look like. There is, thus, no requirement in the general case that we have an effective procedure for determining whether a statement is a complete answer to a question, or indeed whether it is an answer at all.

The distinction between abstract questions and the ways they are presented to us is clearest when the questions are about objects, which may be given from many different perspectives. Thus, to the question *Who did John see?*, the response

John saw Bill.

is, technically, not even a partial answer, since we are not given which object as value of the interrogative variable α is the reference of *Bill*.

In context, however, matters are not so bleak. We can conceive that the values of the variable are referred to by antecedently given singular terms, and thus regard the response as a partial answer after all. More generally, given an abstract question $\Pi = \pi(\theta(\alpha)[K]) + [\phi(\alpha)[K]]$, where ϕ is the restriction on the values of α , K is the class of objects satisfying it, and $\theta(\alpha)$ is the matrix predicate over which the partition is constructed, and given a class C of closed singular terms in 1-1 correspondence with the members of K , if $[\phi(\alpha)[C]]$ is $\{\phi(c/\alpha): c \in C\}$ and $\pi(\theta(\alpha)[C])$ is the partition obtained from $\pi(\theta(\alpha)[K])$ by replacing the objects in K by the respective terms in C that refer to them, we may define

$$\Pi_C = \pi(\theta(\alpha)[C]) + [\phi(\alpha)[C]]$$

as the *presentation* Π_C of Π with respect to the substitution class C .

A presentation of an abstract question is an abstract question in its own right. In practice we are interested in presentations. If Jones asks me who is playing which position in the outfield, and I respond that the left fielder is playing left field, the right fielder is playing right field, and the center fielder is playing center field, I have understood his question all right, and feign not to understand his presentation. It should not be inferred, however, that we can take the presentations and let the questions of which they are presentations go. We can, for example, ask questions whose presentations we know we would not recognize, or for which we have no particular presentations in mind. Furthermore, by relating abstract questions to their presentations, we clarify for instance the sense in which we say two persons may ask the same question, perhaps without realizing it.

Special attention must still be paid to questions $[\text{WH}\alpha: \phi(\alpha)] ? \theta(\alpha)$ where in fact nothing satisfies ϕ at all. Their abstract questions will be $\{F\}$, and so not distinct from any number of other questions expressing

$\{F\}$. Going intensional does not ameliorate the situation, since there are also restrictions $\phi(\alpha)$ that are not even possibly satisfied by anything. These cases underscore the fact that in practice the presentations are more nearly what matters to us than the questions they represent. I do not see this consequence as a difficulty of principle; but it does show that a full pragmatic theory must consider the case where a person for instance thinks she is asking a nondegenerate question, but fails to do so.

A further pragmatic and computational issue that is clarified by the conception of abstract questions as partitions, and of partial answers as statements or sets of statements that eliminate certain of the possibilities that the cells of the partitions represent, is that of interpreting what Hintikka (1976) has called the *desideratum* of a question, or the quantity of information that is wanted by the person asking it. A simple *wh*-question such as example (8), repeated here, may be associated with different desiderata.

(8) Who did John see?

On the view that I have defended, (8) has the logical form (9),

(9) $[\text{WH}\alpha: \text{person}(\alpha)] ? \text{John saw } \alpha$

and the partition it expresses runs through all the possibilities for John's seeing of persons in the domain of quantification, or at least all that are left open by the background theory.

The desideratum of (8) is, therefore, not represented in the question expressed. But desiderata can be so expressed, and among these (as Belnap and Hintikka have pointed out) the *existential*, represented by (72), and the *universal*, represented in Southern American English by (73), are quite common.

(72) Who for example did John see?

(73) Who-all did John see?

(72) asks for an example, and (73) for an exhaustive list, of persons John saw. But intermediate desiderata are possible, as in (74).

(74) Who are two or three people John saw?

The desideratum of an abstract question may be regarded as a set of statements, namely, those that are "sufficiently informative" (even if possibly false) with respect to that abstract question. Each abstract question comes with its own *minimal desideratum*, namely, those statements that are partial answers to it. But not all partial answers meet even the existen-

tial desideratum; thus, (75) is a partial answer to (9), but would not meet the desideratum that at least one value of α be supplied that is a person John saw.

(75) John saw Mary or Bill.

This desideratum, signaled explicitly in (72), is the class of those S implying, for some person a , *John saw c_a* . Similarly, the desideratum of (73) is

$\{S: \text{For all persons } a, S \text{ implies } \textit{John saw } c_a \text{ or } \neg(\textit{John saw } c_a)\}$

Note that (74) has a desideratum in between the universal and the existential. Desiderata may also involve substantive conditions not limited to quantity, as in (76).

(76) What is a surprising/routine example of popular novel?

In general, a partial answer to an abstract question $\mathcal{Q}$ with desideratum D is a statement in D that is a partial answer to $\mathcal{Q}$; and the ordering of desiderata by stringency corresponds to an ordering of partial answers by informativeness.

I return now to some points about quantifying into questions. First of all, with which natural-language quantifiers can one quantify in? Certainly, I think, with all of those that are not monotone-decreasing in the sense of Barwise and Cooper (1981), where a quantifier Q , interpreted via a map f_Q from ordered pairs of subsets of the domain A of quantification into truth values, is monotone-decreasing if $f_Q(X, Y) = \text{truth}$ and $X' \subseteq X$ then $f_Q(X', Y) = \text{truth}$. Examples of quantifiers not monotone-decreasing have been used in the illustrations above. Monotone-decreasing quantifiers, such as *at most two people* (77) or (at an extreme) *no one* (78), can never take wide scope.

(77) What do at most two people have to say?

(78) Is no one at home?

The reason is intuitively clear: it is that, when a question $[\text{WH}\alpha: \phi(\alpha)]$? $\theta(x, \alpha)$ is to be answered for at most two values of x , as in (77), or for none of them, as in (78), then it may be answered by answering for none—that is, by saying anything at all. This intuition corresponds to the feature of our construction that since there is a bloc for each set of persons consisting of at most two of them (for (77)) or none of them (for (78)), there is in each case a bloc for each set of persons consisting of none of them—that is, a bloc $\{\{F\}\}$. Answerhood then becomes degenerate. From the defini-

tion, S answers either of the questions expressed by (77) or (78) with the quantifier taking wide scope if S answers $\{F\}$, the sole question in the bloc $\{\{F\}\}$, and it answers $\{F\}$ if inconsistent with F , an unsatisfiable sentence. Then S answers F , and so answers the question, no matter what S may be.

6 Mood and Reference

My discussion thus far has gone forward on the assumption that theses 1 and 2 of my introduction are correct: namely, that interrogative sentences express abstract questions, and embedded interrogatives refer to the questions that would be expressed by their direct counterparts. There are three major alternatives to these assumptions.

The first, which has been taken up in various forms, is that the interrogative, like the imperative, optative, and perhaps other moods, is constructed by attaching an indicator of mood to an indicative (moodless) core. The meaning of the mood indicator then becomes an issue, and the issue of the reference of indirect questions is left up in the air. However, the idea that the difference between

It is raining.

and

Is it raining?

semantically speaking is only in their mood and not in their content is one that has enjoyed wide appeal, and I will therefore consider it in some detail.

The second alternative, elaborated especially by Jaakko Hintikka, is that all questions, whether direct or indirect, dissolve upon analysis into the more ordinary apparatus of propositional attitudes and ordinary quantifiers. On this view, not only are there no moods but there are also ultimately no quantifications like *wh* distinctive of questions. This view faces serious difficulties once we move outside direct questions and the complements to epistemic verbs and propositional attitudes, as noted by Karttunen (1977); I will therefore say no more about it here.

The third alternative, which has been prominent from time to time and is defended elegantly if briefly by Lewis (1972), is that all questions are really indirect, and apparently direct questions amount to indirect questions as complements of an unexpressed performative prefix, with the meaning of “I ask,” or “I ask you.” To the obvious objection that it seems absurd to call interrogatives true or false, it may be responded that we do

not call performatives true or false either. However, on the view I will defend, this alternative is not so much mistaken as it is redundant: of course it is true that whoever utters an interrogative asks a question; but we do not need the higher-performative analysis to explain this.

A theory of meaning must explain why uttering an indicative sentence is saying something (not necessarily asserting it), and it must explain why uttering a *that*-clause is not saying anything, but simply referring to a proposition. The explanation in truth-conditional semantics is that only sentences, or utterances of sentences, admit of truth and falsehood. That is why, in uttering a sentence, one may, in Wittgenstein's words, "make a move in the language game," and inversely why in uttering a *that*-clause in isolation no move is made at all.

This explanatory charge carries over to nonindicatives. In uttering the question *whether it is raining* one merely refers to a question, but in uttering *Is it raining?* that question is necessarily asked. But since direct questions do not appear to have truth values, the sense in which utterances of them must ask things is not apparent.

The higher-performative analysis reduces the problem of direct questions to the previous case of indicatives. Utterances of *Is it raining?* are regarded as notational variants of utterances of *I ask (you) (the question) whether it is raining*. Since the latter are indicatives, and say things, so do the former. The type of saying is asking, since that concept was built into the analysis.

But in fact all of this is unnecessary. Just as the semantic value of an indicative is a truth value, so the semantic value of a direct yes-no question is an unordered pair of truth values, one for each cell of its partition. Just as the semantic value of a *that*-clause is a proposition, so the semantic value of an indirect yes-no question is an unordered pair of propositions, and just as the proposition that it is raining is expressed by *It is raining*, so the pair {the proposition that it is raining, the proposition that it is not raining} is expressed by *Is it raining?*. It follows immediately: first, that interrogatives cannot be called true or false; and second, if we assume that *ask* is nothing but that variant of *say* whose proper objects are questions, that whoever utters an interrogative asks a question.

Care must be taken in not freighting up the notion of asking here with any of the motives for raising a question. English has *say* and *assert*, where to assert is to say with assertive force. The verb *ask*, however, is ambiguous. In one sense it amounts to *say*, but its objects must be questions. In another sense it involves what we might call interrogative force (and is so understood in the higher-performative analysis). One can raise

questions to which one perfectly well knows the answer, or doesn't care what the answer may be, and one can also raise questions nonseriously. An actor on a stage says things without asserting them, and utters questions without interrogative force. I take it: that the verb *ask* may be so understood that an utterance by *a* of (79) justifies the subsequent assertion by anyone of (80).

(79) Is dinner ready?

(80) *a* asked whether dinner was ready.

The position I have outlined may be clarified by being expressed in an extension of the language IL of intensional logic. In that language there are sentences of the syntactic type *t* of truth values and expressions for propositions, of syntactic type (s, t) , corresponding semantically to propositions—that is, sets of possible worlds. Interrogatives as I have interpreted them here would call for an extension of the type theory so that there would be a type $\{t, t\}$ of unordered pairs of type *t*, whose semantic interpretation would be unordered pairs of truth values, and a type $\{(s, t), (s, t)\}$ of unordered pairs of propositions. Verbs like *ask* and *wonder* would take arguments of this type. In this setting, the extension of an interrogative is a pair of truth values, and its intension a pair of propositions. Indeed, the account of interrogatives given here can be expressed in its entirety in the setting envisaged.

If we assume that the reference of indirect questions is as I have suggested, then the higher-performative analysis of direct questions becomes redundant. Whether that analysis is adopted or not, however, the semantics of interrogatives does not take us out of the truth-conditional arena. In particular, there are no moods in the semantics of questions, either because they are not represented at all, or because any work they might have done is taken up by the higher performative verb. However, there is a weighty tradition of thinking of moods as semantically independent items. and I wish to turn briefly to the difficulties in making out just what this tradition has in mind.

The question we were considering was, Why can saying an interrogative sentence such as (81) constitute asking a question, namely, the question whether (82)?

(81) Is it raining?

(82) It is raining.

An answer that suggests itself is that the syntactic element represented in English by inversion and a characteristic intonation pattern, and in other

languages by other syntactic devices, is a sign that the speaker of the sentence is performing a speech act with interrogative force, whose content is given by the clause on which the syntactic element operated. Thus, the datum (83) is an application of a rule of English.

- (83) If *u* is an utterance of (2), then the speaker of *u* asks (with interrogative force) the question whether (82).

As Davidson (1979) points out, however, the above and kindred conceptions of mood fail to make room for nonserious uses of language. Taken quite literally, this account of mood implies that when the minister at a wedding rehearsal says (84),

- (84) Do you take this woman for your wife?

then he (or she) is asking with interrogative force whether the man addressed takes that woman for his wife. But he is not, in the desired sense, asking anything; it is only a rehearsal.

Note that the higher-performative analysis does not face counterexamples along these lines. Whether the minister is asking anything is determined by whether (85), which is what he in fact said, is true.

- (85) I ask you whether you take this woman for your wife.

But since we are only at a rehearsal, it is not true. My own view, which does not recognize a higher performative, has it that the minister in a sense asks a question, but without interrogative force.

The theory of mood developed in Davidson 1979 is specifically designed to allow for nonserious uses of language. Davidson's suggestion is that yes-no questions are a kind of portmanteau, where the indicator of mood, or as he calls it the mood-setter, functions as a comment on the indicative core. Thus, *Is it raining?* is understood as in (86).

- (86) It is raining. That was interrogative in force.

The minister at the wedding rehearsal says nothing with interrogative force, even though in a way he says he does.

It is obvious that Davidson's suggestion runs into difficulties with *wh*-interrogatives (as Davidson notes in 1979: 115), although it might be suggested that the indicative core is in this case an open sentence or utterance. But does his view really explain why interrogatives cannot be assessed for their truth values? Hornsby (1986) suggests that the explanation offered—namely, that interrogatives are a portmanteau of two sentences—is rather weak; for the same problem in more detail, see Segal 1988. Hornsby her-

self proposes that the convention or rules of language governing interrogatives be expressed adverbially, as in (87).

- (87) By saying *Is it raining?* a speaker says interrogatively that (or: asks-whether) it is raining.

To say no more than this about interrogatives is to leave indirect questions in the lurch, as Hornsby recognizes. But her aim is to formulate a view according to which the speaker in asking a question is not, in contrast to Davidson's view, tacitly describing with words what he is doing. Still, the expression *says interrogatively* is left as an unanalyzed term of art. If it were interpreted as *says with interrogative force*, then I do not see that we would have better than Davidson's theory back again.

Now, if I am right to say that yes-no questions express partitions, unordered pairs consisting of a proposition and its negation, then we have an explanation of why yes-no questions may but need not have interrogative force that is parallel to the explanation of why indicatives may but need not have assertive force. There is no need of mood indicators at all, for the semantic work done by syntactic inversion or the abstract question morpheme formalized above by the question mark is just to convert propositions into appropriate unordered pairs. Indeed, the view that I have advocated here is partly based on the following thought: any correct account of indirect questions must assign them a reference, and that reference will have the property that, when presented via a main clause, its presentation can, but need not, constitute asking about it. If so, then we needn't suppose that an interrogative does not wear its whole logical syntax on its face.

Appendix: Licensing Negative Polarity

The English negative polarity items *any* and *ever* are freely licensed in interrogative environments, as in (88) and (89).

- (88) Did anybody speak?

John wonders whether anybody spoke.

*Anybody spoke.

- (89) Have you ever been to France?

Whether he has ever been to France is known to the police.

*He has ever been to France.

*That he has ever been to France is known to the police.

In this appendix I will offer an explanation of such licensing, drawing on the discussion above and on the fuller account of English choice questions developed in Higginbotham 1991a.

Following the latter paper, I will assume without argument that English disjunction *or* is always to be construed as in construction with a possibly tacit occurrence of *either*, and that the latter is a quantifier admitting a universal interpretation. The data that support this view are exemplified by the ambiguity of modal sentences such as (90).

(90) John will play chess or checkers.

Besides the obvious interpretation that John will play chess, or else he will play checkers, (90) also has an interpretation equivalent to

John will play chess and John will play checkers.

The second interpretation, I will assume, arises because (90) has in fact a syntactic structure as in (91),

(91) [either]_i [John will play [chess or checkers]_i]

and at LF a structure as in (92).

(92) [either chess or checkers]_i [John will play *t_i*]

The prefix is a universal quantifier, so that we have in effect (93).

(93) [∀*x*: *x* = chess or *x* = checkers] John will play *x*

Proceeding now beyond my earlier discussion, I will assume that the syntax of (90) puts *either* in the Spec position of its clause, so that we have at LF (94).

(94) [_{CP} [_{Spec} either chess or checkers]_i [_C *C* [_{IP} John will play *t_i*]]]

This assumption is more specific than I will actually require. What will be necessary is that there be an intervening position, here *C*, between the quantification and the sentence over which it quantifies, and that this position be interpreted as the '?' of the discussion above is interpreted—that is, as passing from the type of propositions to the type of partitions.

It is obvious that English *whether* is *wh* + *either*, as *when* is *wh* + *then*, *where* is *wh* + *there*, and so on. Suppose now that this etymological point has semantic significance, so that *whether* is interpreted as a universal quantification in [Spec, CP], hence outside the scope of '?' in *C*. Unlike *either*, and unlike other *wh*-words, *whether* is restricted to this syntactic position. Thus, we do not have (95), in contrast to (96) or (97).

(95) *Who saw whether Mary or Bill?

(96) Who saw either Mary or Bill?

(97) Who saw who?

We may assume further that just as every occurrence of *either* must go together with an occurrence of the disjunction *or*, so must every occurrence of *whether*, the sole exception being the case where the disjunction is tacit, and over the whole indicative IP. Thus, (98) will have a structure as in (99), and (100) a structure as in (101), prior to ellipsis.

(98) whether John played chess or checkers

(99) [_{CP} [_{Spec} whether]_i [_C [_C ?] [_{IP} John played [chess or checkers]_i]]]

(100) whether John left (or not)

(101) [[whether] ? [John left or John did not leave]]]

Consider now the LF representation and the accompanying semantics of (101) on the assumptions given. The representation will be (102), and its interpretation will be that of (103).

(102) [[whether John left or John did not leave]_i [? *t_i*]

(103) [∀*p*: *p* = that John left or *p* = that John did not leave] ? *p*

Applying the semantics, the constituent '?*p*' expresses the partition

{*p* !, ¬*p*}

with '*p*' a free variable. Quantification into this position by the universal quantifier gives the question of order 1

{{John left !, John did not leave}, {¬(John left) !, ¬(John did not leave)}}

Manifestly, the latter is equivalent, in the sense of having all the same partial and complete answers, to

{John left !, John did not leave}

so that the quantification has accomplished nothing, semantically speaking.

On the assumptions stated, however, *whether*-questions in which the scope of *whether* is the whole clause all have the property at LF that the elements of the clause appear within the restriction of a universal quantification, and such appearance is known to license negative polarity items. For the licensing itself I will adopt the explanation proposed by Ladusaw (1983) and others, that negative polarity items may appear only within the scope of *downward-entailing* expressions (definitions and a theoretical dis-

cussion are provided below). It follows at once that negative polarity items are licensed within interrogatives, where the licenser is overt or tacit *whether*.

A crucial point for the above analysis of the licensing of negative polarity items in interrogatives is seen in minimal pairs such as (104)–(105) and (106)–(107).

(104) Mary knows whether John played chess or checkers.

(105) Mary knows whether anyone played chess or checkers.

(106) Did John play chess or checkers?

(107) Did anyone play chess or checkers?

(104) and (106) are of course ambiguous. On the view taken here, the ambiguity derives from the possibility of construing the disjunctive constituent *chess or checkers* either with *whether*, giving the interpretation of the embedded clause as a choice question, or else with its own tacit *either* within that constituent, giving the interpretation of that clause as a yes-no question. But (105) and (107) are not ambiguous: the complement cannot be interpreted as a choice question about chess versus checkers. The explanation in terms of the analysis above is that for the choice question we have the representation (108).

(108) [[whether chess or checkers]_i] [_i [John/anyone played *t_i*]]

But this representation fails to license the negative polarity item *anyone*. To license it, we require that the entire clause *anyone played chess or checkers* be within the scope of *whether*, as in (109).

(109) [[whether anyone played chess or checkers (or not)]_i] [_i *t_i*]

But then the disjunction of *chess* or *checkers* is not construed with *whether*, so that the possibility of a choice question is precluded.

The interpretation of *whether* as universal quantification is not confined to the domain of interrogatives, but is corroborated by the use of *whether* analogous to a free relative pronoun, as in (110).

(110) You'll have a good time whether you go to London or Paris.

The sentence means that you'll have a good time if you go to London, and also if you go to Paris. This interpretation follows from the assignment of the LF representation (111), or, with variables explicit, (112).

(111) [whether London or Paris]_i [you'll have a good time if you go to *t_i*]

(112) [$\forall x: x = \text{London or } x = \text{Paris}$] [you'll have a good time if you go to *x*]

When negative polarity is licensed within the scope of some other *wh*-expression than *whether*, as in (113), we assume that a tacit *whether* is present anyway, giving the LF representation (114).

(113) Who had anything to say?

(114) [$\text{WH}\alpha$] [$\forall p: p = \text{that } \alpha \text{ had anything to say or } p = \text{that } \neg(\alpha \text{ had anything to say})$] ? *p*

The equivalences noted above carry over to this case, so that the interpretation is not disrupted.

There are a number of further linguistic points relevant to the hypothesis presented here that I hope to expand upon in later work. To review, the hypothesis is that negative polarity items are licensed in interrogatives because the latter are governed by the disjunction-host *whether*. This word behaves like its counterpart *either* in admitting an interpretation as a universal quantification. When that quantification is over propositions, then the constituents of the interrogative clause will be within its scope, and the environment will satisfy known conditions on the licensing of negative polarity in English.

I turn now to some formal points that have been so far left in abeyance. Ladusaw's notion of downward-entailingness is defined in terms of implication, and thus applies in the first instance only to indicative sentences. A quantifier *Q* is downward-entailing (with respect to its restriction) if the schema in (115) is valid.

$$(115) \frac{[Qx: F(x)] G(x) \quad [\forall x: H(x)] F(x)}{[Qx: H(x)] G(x)}$$

By analogy with the indicative case, an expression of generality *Q* (which may be a quantifier, *wh*, or perhaps a "mix" of the two, such as *which two*) will be said to be *downward-entailing for interrogatives* if, where $\mathcal{Q}$ is the question expressed by the result of prefixing ' $[Qx: F(x)]$ ' to ' $?G(x)$ ', and $\mathcal{Q}'$ is the question expressed by the result of prefixing ' $[Qx: H(x)]$ ' to ' $?G(x)$ ', then we have (116).

(116) If [$\forall x: H(x)$] *F(x)*, then if *S* is a partial (complete) answer to $\mathcal{Q}$, then *S* is a partial (complete) answer to $\mathcal{Q}'$.

In other words, speaking derivatively in terms of answers to sentences rather than to the questions they express, the schema (117) is valid.

(117) S partially (completely) answers $[Qx: F(x)] ? G(x)$
 $[\forall x: H(x)] F(x)$

S partially (completely) answers $[Qx: H(x)] ? G(x)$

We shall need the observation about quantifiers in natural language that they are all *intersective* in the sense of Higginbotham and May (1978, 1981). I construe quantifiers Q as model-theoretically interpreted by functions f_Q from ordered pairs (X, Y) of subsets of the domain of quantification A into truth values. Q is *intersective* if

$$f_Q(X, Y) = f_Q(X, X \cap Y)$$

From intersectivity it follows that a natural-language quantifier that is downward-entailing, or for purposes of this exposition *downward-entailing (DE) for indicatives*, is DE for interrogatives as well. For suppose that Q is DE for indicatives, and let S be a partial answer to (118).

(118) $[Qx: F(x)] ? G(x)$

Each question $\mathcal{Q}_a$ expressed by “ $?G(x)$ ” when a is assigned to x will be of some given order n , the same for all a . If $\bar{F}$ is the extension of ‘ F ’, then for every subset A' of $\bar{F}$ such that $f_Q(\bar{F})(A') = \text{truth}$, there is a bloc $B_{A'}$ in the question $\mathcal{Q}$ of order $n + 1$ expressed by (118), and $\mathcal{Q}$ consists entirely of such blocs. Since S answers $\mathcal{Q}$, there is a bloc B in $\mathcal{Q}$ and a subset A' of $\bar{F}$ such that S answers $\mathcal{Q}_a$ for every $a \in A'$. Consider the interrogative (119).

(119) $[Qx: H(x)] ? G(x)$

If $\bar{H}$ is the extension of ‘ H ’, then since Q is DE for indicatives, if $\bar{H} \subseteq \bar{F}$ then $f_Q(\bar{H})(A') = \text{truth}$. Since Q is intersective, $f_Q(\bar{H})(\bar{H} \cap A') = \text{truth}$. Then S answers every $\mathcal{Q}_a$ for $a \in \bar{H} \cap A'$, and is therefore an answer to (119); and S is a complete answer if it was a complete answer to (118). So if Q is DE for indicatives and Q is intersective, then Q is DE for interrogatives. Since all natural-language Q are intersective, this completes the proof.

The converse inclusion, that if Q is DE for interrogatives it is also DE for indicatives, requires stronger assumptions than the intersectivity of Q . Following the customary terminology, say that Q is *monotone-increasing (-decreasing)* if $f_Q(X)(Y) = \text{truth}$ and $Y \subseteq Z$ ($Z \subseteq Y$) implies $f_Q(X)(Z) = \text{truth}$, and *indefinite* if $f_Q(X)(Y) = f_Q(Y)(X)$, for all X, Y , and Z . All natural-language quantifiers are monotone-increasing, monotone-decreasing, or indefinite (including combinations of these). If Q is monotone-decreasing, then Q does not quantify into interrogatives,

and we have seen pragmatic reasons why. For those same pragmatic reasons, we may assume that $f_Q(\phi)(Y) = \text{falsehood}$, and, if Q is indefinite, that $f_Q(X)(\phi) = \text{falsehood}$ as well.

Suppose then that Q is not DE for indicatives, and consider a model $\mathcal{M}$ where (120) and (121) are true and (122) is false.

(120) $[Qx: F(x)] G(x)$

(121) $[\forall x: H(x)] F(x)$

(122) $[Qx: H(x)] G(x)$

Then the extension $\bar{F}$ of ‘ F ’ is nonempty. Consider with respect to this model the interrogatives (123) and (124).

(123) $[Qx: F(x)] ? (G(x) \& H(x))$

(124) $[Qx: H(x)] ? (G(x) \& H(x))$

We are going to show that there is a true partial answer to (123) that is not a partial answer to (124), so that Q is not DE for interrogatives either. Assume on the contrary that Q is DE for interrogatives.

Because (120) is true in $\mathcal{M}$, the question expressed by (123) in $\mathcal{M}$ will have a bloc for the nonempty subset $\bar{F} \cap \bar{G}$ of $\bar{F}$. Hence, if there is an object a in $\mathcal{M}$ that lies in $\bar{F}$ and $\bar{G}$ but not in $\bar{H}$, then (125) is a true partial answer to (123) that is not a partial answer to (124).

(125) $G(a) \& \neg H(a)$

Hence, $\bar{F} \cap \bar{G} \subseteq H$. Then Q cannot be indefinite; for if it were, then since it follows from the truth of (121) in $\mathcal{M}$ that $\bar{F} \cap \bar{G} = \bar{G} \cap \bar{H}$, and the truth values of (120) and (122) depend only on the respective cardinalities of $\bar{F} \cap \bar{G}$ and $\bar{G} \cap \bar{H}$, these formulas would have the same truth value in $\mathcal{M}$, contrary to hypothesis. The only remaining possibility is that Q is monotone increasing, but not indefinite. The blocs of the question expressed by (124) in $\mathcal{M}$ correspond to those subsets Σ of $\bar{H}$ for which $f_Q(\bar{H}, \Sigma) = \text{truth}$. If we could choose $\Sigma \subseteq G \cap H$, then since Q is monotone-increasing, (122) would be true in $\mathcal{M}$. If there are no Σ for which $f_Q(\bar{H}, \Sigma) = \text{truth}$, then the question expressed by (124) in $\mathcal{M}$ is degenerate, and so has no proper partial answers. But otherwise there are elements in $\bar{G}$ that are not in $\bar{H}$; and by the previous argument (125) is then a partial answer to (123) but not to (124).

The proof above can be strengthened to show that there are complete answers to (123) that are not complete answers to (124). I omit the details here.

Notes

Most of this paper is expanded from the less technical parts of one presented at a meeting of the Ockham Society, Oxford, March 1990, Roger Teichmann commenting; at the Workshop on Logical Form, University of California, Irvine, April 1990; and at the meeting of the Association for Symbolic Logic, Carnegie-Mellon University, Pittsburgh, January 1991. Other material is new, and some of it would not have been possible without class discussion in a seminar at MIT in the spring term of 1992 taught jointly with Irene Heim. For a technical supplement on direct questions, see Higginbotham 1991b:secs, 6 and 7. I have incorporated some remarks prompted by Teichmann's comments, and discussions with a number of persons, including especially Utpal Lahiri, Gabriel Segal, and Robert Stainton, have also been very helpful.

I note here the background to this paper. My first work on the topic of interrogatives was carried out jointly with Robert May, and some was published in Higginbotham and May 1978, 1981. I presented a more extended view at the CUNY Graduate Center, New York, October 1978, and at MIT, November 1979. This work was influenced particularly by Levi (1967); May (1989) has also carried out some of the further development. Further research was done at the University of Texas at Austin in 1980 under grant BNS 76-20307 A-01 from the National Science Foundation. I am grateful to Stanley Peters for this opportunity, and to him, Hans Kamp, and Lauri Karttunen for comments and discussion. The views that I then arrived at, and presented in a seminar at MIT in 1982 together with Sylvain Bromberger, I subsequently found to overlap in part with the research report Belnap 1963, some of the material from which was published as Belnap and Steel 1976. Discussion with Belnap at a conference sponsored by the Sloan Foundation at McGill University, 1982, confirmed that the method he and Michael Bennett envisaged for adding quantification over questions was similar to mine as well. (I have noted below where I follow Belnap's terminology, but have not in general cited specific parallels to his work.) Finally, Groenendijk and Stokhof (1984, 1989) have independently arrived at a view of what simple interrogatives express that is similar to what I advance here in section 1.

1. Belnap (1969) observes that interrogatives may be expected to have presuppositions even for a language whose indicatives do not.
2. The presuppositions of multiple singular *wh*-questions are examined in Barss 1990.
3. See May 1985.
4. For a different implementation of the same basic idea, see Belnap 1982, following work by Michael Bennett.
5. If the background theory is ω -incomplete, even finiteness (or emptiness) of the set of positive instances is not enough to guarantee that an answer is attainable. For example, let the background theory be Peano arithmetic, where $\mathcal{P}$ represents provability and $g+$ is the numeral for the Gödel number of a sentence g provably equivalent to its own unprovability, and consider (i), representing the question *What is a proof of g ?*

- (i) $[\text{WH}\alpha] ? \mathcal{P}(\alpha, g+)$

In the standard model, only the cell containing ' $\neg \mathcal{P}(a+, g+)$ ' for each numeral $a+$ is consistent with the background theory, but the true and complete answer ' $(\forall x) \neg \mathcal{P}(x, g+)$ ' is not provable.

6. There is another, irrelevant interpretation of (41), parallel to the natural interpretation of *I wondered about school*.
7. In the interest of readability I omit extra curly brackets when no ambiguity threatens. Thus, what is displayed in the text would be fully articulated as $\{\{p\}; \{\neg p\}\}$; similarly for a number of later examples.
8. I believe that the functional interpretation also provides the proper mechanism for the examples in Geach 1969 such as (i) (p. 121).
- (i) The one woman whom every true Englishman honors above all other women is his mother.
9. Examples like (66) are due to Engdahl (1986); (65) is modeled after an example in Collins 1992.
10. See Kroch 1989, Cinque 1990, and Szabolcsi and Zwarts 1990 for a discussion of ambiguities of this type.

References

- Barss, A. 1990. Optional movement, absorption, and the interpretation of WH-in-situ. Paper presented at NELS 21, Université du Québec à Montréal. Ms., University of Arizona.
- Barwise, J., and R. Cooper. 1981. Generalized quantifiers and natural language. *Linguistics and Philosophy* 4.2: 159–219.
- Belnap, N. 1963. *An analysis of questions: Preliminary report*. Technical Memorandum 7 1287 1000/00, System Development Corporation, Santa Monica, Calif.
- Belnap, N. 1969. Questions: Their presuppositions, and how they can fail to arise. In *The logical way of doing things*, ed. K. Lambert, 23–38. New Haven, Conn.: Yale University Press.
- Belnap, N. 1982. Questions and answers in Montague Grammar. In *Processes, beliefs, and questions*, ed. S. Peters and E. Saarinen, 165–98. Dordrecht: Reidel.
- Belnap, N., and T. Steel. 1976. *The logic of questions and answers*. New Haven, Conn.: Yale University Press.
- Berman, S. 1989. The analysis of quantificational variability in indirect questions. Ms., University of Massachusetts, Amherst.
- Bromberger, S. 1966. Questions. *The Journal of Philosophy* 63: 597–606.
- Chierchia, G. 1991. Functional WH and weak crossover. In *Proceedings of the Tenth West Coast Conference on Formal Linguistics*, 75–91. Stanford Linguistics Association, Stanford University, Stanford, Calif.
- Cinque, G. 1990. *Types of $\bar{A}$ -dependencies*. Cambridge, Mass.: MIT Press.

- Collins, C. 1992. A note on quantifying into questions and functional readings. Ms., MIT.
- Davidson, D. 1979. Moods and performances. In *Meaning and use*, ed. A. Margalit, 9–20. Dordrecht: Reidel. Reprinted in D. Davidson, *Inquiries into truth and interpretation*, 109–21. Oxford: Oxford University Press (1984).
- Engdahl, E. 1986. *Constituent questions*. Dordrecht: Reidel.
- Geach, P. 1969. Quine's syntactical insights. *Synthese* 19.1/2. Reprinted in P. Geach, *Logic matters*, 115–27. Oxford: Basil Blackwell (1972).
- Groenendijk, J., and M. Stokhof. 1984. Studies on the semantics of questions and the pragmatics of answers. Doctoral dissertation, University of Amsterdam.
- Groenendijk, J., and M. Stokhof. 1989. Type-shifting rules and the semantics of interrogatives. In *Properties, types, and meaning*. Vol. II: *Semantic issues*, ed. G. Chierchia et al., 21–68. Dordrecht: Kluwer.
- Hamblin, C. 1973. Questions in Montague English. *Foundations of Language* 10:41–53. Reprinted in *Montague Grammar*, ed. B. Partee, 247–59. New York: Academic Press (1976).
- Higginbotham, J., and R. May. 1978. A general theory of crossing coreference. *CUNYForum: Proceedings of NELS IX*, 328–36. Graduate Center of the City University, New York.
- Higginbotham, J., and R. May. 1981. Questions, quantifiers, and crossing. *The Linguistic Review* 1:41–80.
- Higginbotham, J. 1991a. Either/or. Forthcoming in *Proceedings of NELS 21*.
- Higginbotham, J. 1991b. Interrogatives I. In *MIT working papers in linguistics* 15, 47–76. Department of Linguistics and Philosophy, MIT.
- Hintikka, J. 1976. *The semantics of questions and the questions of semantics*. Acta Philosophica Fennica 28, 4. Amsterdam: North-Holland.
- Hornsby, J. 1986. A note on non-indicatives. *Mind* 95:92–99.
- Karttunen, L. 1977. The syntax and semantics of questions. *Linguistics and Philosophy* 1:3–44.
- Kroch, A. 1989. “Long” WH-movement and referentiality. Ms., University of Pennsylvania.
- Ladusaw, W. 1983. Logical Form and conditions on grammaticality. *Linguistics and Philosophy* 6:373–92.
- Lahiri, U. 1990. Questions, answers, and selection. Ms., MIT.
- Lahiri, U. 1992. Embedded interrogatives and the predicates that embed them. Doctoral dissertation, MIT.
- Levi, I. 1967. *Gambling with truth*. New York: Alfred E. Knopf.
- Lewis, D. 1972. General semantics. In *Semantics of natural language*, ed. D. Davidson and G. Harman, 169–218. Dordrecht: Reidel.

- May, R. 1985. *Logical Form: Its structure and derivation*. Cambridge, Mass.: MIT Press.
- May, R. 1989. Interpreting Logical Form. *Linguistics and Philosophy* 12:387–435.
- Pesetsky, D. 1982. Paths and categories. Doctoral dissertation, MIT.
- Reinhart, T. 1992. Interpreting WH-in-situ. Ms., Tel Aviv University.
- Segal, G. 1988. In the mood for a semantic theory. Ms., King's College, London.
- Szabolcsi, A., and F. Zwarts. 1990. Semantic properties of composed functions and the distribution of WH-phrases. In *Proceedings of the Seventh Amsterdam Colloquium*, ed. M. Stokhof and L. Torenvliet, 529–54. Institute for Language, Logic, and Information, University of Amsterdam.