What questions mean

By Paul Hagstrom

1. Introduction and statement of purpose
The semantics of questions is a fabulously complex area of research with a very active literature and no shortage of theoretical positions often differentiated by seemingly minute details. My goal in this article is necessarily somewhat modest: to introduce some basic concepts in order to highlight some of the issues and discoveries that have been occupying the recent literature on the semantics of questions. At the same time, I aim to keep the discussion accessible to those who are just poking their heads in to see what we're up to over here. There are three recent handbook articles, Groenendijk & Stokhof (1997), Higginbotham (1996), and Ginzburg (1996), that can provide a better historical perspective and a broader look at the sub-field at large. Corners will be cut here, and some approaches and results will undeservedly not be covered at all.

2. Three postulates at the dawn of history
History, for the purposes of this article, began in 1958, with the publication of a short paper by C.L. Hamblin, wherein he takes an inspired stab at bringing questions into the fold of formal semantics. Questions differ from statements in an important way: A statement is sometimes true, sometimes false—but a question is never either. The conundrum is that the formal semantics designed to handle statements—which was working rather nicely for the prehistoric semanticists—is fundamentally about the conditions under which things are true, leaving no clear place in the system for a question (or anything with a meaning but no truth value).

Hamblin proposed a set of postulates to get us started, by relating questions to the statements that we already knew how to handle:

Postulate I: An answer to a question is a statement.
Postulate II: Knowing what counts as an answer is equivalent to knowing the question.
Postulate III: The possible answers to a question are an exhaustive set of mutually exclusive possibilities.

The first postulate formalizes the idea that a statement (a proposition), is the basic unit of information. It implies that "fragment" answers, which communicate information, are really standing in elliptically for the whole statement: If one answers *Who left?* with *Pat*, one has communicated the information *Pat left*.

The second postulate establishes the same kind of foothold for questions that we had with statements: Just as the content of a proposition is known when the conditions under which it is **true** are known (its **truth** conditions), the content of a question is known when the conditions under which it is **answered** are known (its **answerhood** conditions). A question, then, picks out a set of propositions: those that count as an answer. As for the exact constitution of that set of propositions and how a question "picks them out," analyses diverge.

We will assume that a proposition is uniquely specified by its truth conditions. We refer to any given state that the universe could be in as a "possible world," making the content of a proposition effectively the collection of possible worlds in which the proposition is true. Thus, if the door over there stands ajar in a particular possible world that we might label w_{37}, then w_{37} will be in the set of possible worlds defining the proposition *The door over there is open* (and in the same set of possible worlds that defines *Yonder door is not closed*). Any set of possible worlds, even those not picked out by any natural language sentence we can readily think of, is a proposition in this sense.

Hamblin's (1958) third postulate embodies the claim that a question divides all of the possible worlds (or, at least, those possible worlds consistent with common background assumptions) into non-overlapping compartments. Thus, we might say that to ask a question is to present a particular way of compartmentalizing possible worlds, with a request for information about which compartment the actual world is to be found in. A simple yes-no question, like *Did Quinn leave?*, divides the possible worlds into two compartments, one containing the possible worlds picked out by the proposition *Quinn left*, and the other containing those picked out by *Quinn didn't leave*. These compartments are exhaustive and mutually exclusive in the sense that in any given possible world, exactly one of the two propositions is true.

3. Hamblin/Karttunen answer sets
Fifteen years later, Hamblin (1973) presented a very influential and somewhat different analysis. His

Paul Hagstrom, Department of Modern Foreign Languages & Literatures, Boston University, 718 Commonwealth Ave., Boston, MA 02215, USA, hagstrom@bu.edu

earlier third postulate was implicitly discarded as he focused on the problem of building up a compositional semantics for questions. At the heart of this analysis is the assumption that the component parts of *Quinn left* and *Who left?* are the same, but for the *wh*-word standing in for *Quinn* in the latter. With some minor amendments to the composition rules, his proposal places the entire burden of building a question on the *wh*-word. The end result is that *Who left?* picks out just those propositions one gets by substituting in people (which is what *who* stands for) in the position of *who*: *Quinn left*, *Wade left*, and so forth. To distinguish this set of propositions from others that will be discussed later, let us call this set of propositions ANSPOSS. Notice, too, that more than one proposition from ANSPOSS could be true in any given possible world. Certainly *Quinn left and Wade left* could be true, although it is not one of the possible answers—it is the conjunction of two of the possible answers, *Quinn left* and *Wade left*.

Hamblin's analysis dealt exclusively with matrix questions, but of course not every question is a performative act. We can refer to questions *as* questions as well, by embedding them in other sentences. Verbs differ in their behavior with respect to embedded questions and embedded propositions. At least at a relatively intuitive level, some verbs, simply by virtue of what they mean, operate on questions (for example, *ask* and *wonder*). Other verbs operate on propositions (for example *know* or *tell*).

That verbs of the first type appear with embedded questions is unremarkable, but examples of verbs of the second type with embedded questions abound as well. When a question is taken as a complement of this second class of verbs, it seems to be viewed from the perspective of its answer. Roughly, if *I know what Pat bought*, then I know the proposition(s) that answer the question *What did Pat buy?*. We will adopt Groenendijk & Stokhof's (1984) labels for these two types of questions, **intensional** (for questions *qua* questions) and **extensional** (for questions *qua* answers).

Karttunen (1977) developed Hamblin's (1973) analysis further by considering the semantics of embedded questions, translating it into a newer semantic framework, and amending it (in a rather minor way). First, Karttunen posits an additional element in the semantic structure of questions, essentially an interrogative complementizer that serves to form a ''proto-question'' of the right semantic type for later composition of *wh*-words. Second, Karttunen, upon consideration of the entailments of a certain class of indirect question, narrowed the set of propositions picked out by the question to just the true ones. The basic inspiration for his modification was the intuition that *I know what Pat bought* implies only that I know the *true* answers to the question *What did Pat buy?*. We will call Karttunen's answer set ANSTRUE, which contains only those propositions from ANSPOSS that are actually true.

4. Groenendijk & Stokhof (1982) on strong vs. weak exhaustivity

Groenendijk & Stokhof (1982) examine in detail the intuitions about embedded questions that led Karttunen to propose ANSTRUE over ANSPOSS, concluding that even Karttunen's amendment is insufficient to capture the facts. Under Karttunen's semantics, to know who left is to know the true propositions that answer *Who left?*—to know, of people that actually left, that they left. Yet, our intuitions are in fact stronger than that: if we know who left, we also know of people who didn't leave that they didn't leave (or, to put it another way, we know for each person whether that person left or not). This does not follow from Karttunen's proposal, which has nothing to say about the false possible answers. Groenendijk & Stokhof label the characteristic of Karttunen's question semantics **weakly exhaustive**, as compared to the **strongly exhaustive** nature of our intuitions in this case.

Observing this, Groenendijk & Stokhof advocate something of a return to Hamblin's (1958) view, in which the answers form mutually exclusive and complete partition of possible worlds. In such a system, *Who left?* divides the possible worlds into (for example) four compartments, defined by the propositions *Wade left alone*, *Quinn left alone*, *Wade and Quinn left*, and *Nobody left*. If knowing who left means knowing which of these four compartments the actual world is in, it will follow that if we know who left, we know for each person whether that person left or not.

A proposition corresponding to one compartment of the partition (such as *Wade left alone*) is a **complete answer** to the question, but we also have the intuition that partial answers are possible: if I answer *Wade left*, I have provided pertinent information. The proposition *Wade left* does not correspond exactly to any of the compartments, but it does rule out two of the possibilities (*Nobody left*, and *Quinn left alone*). It constitutes a **partial answer** to the question (see also Higginbotham & May 1981 for discussion). The partition view allows a distinction to be drawn between partial answers and irrelevant statements, one that is difficult to state under Karttunen's view (since the relevant *Quinn didn't leave* and irrelevant *Yonder door is not open* would have the same status with respect to the question *Who left?*: propositions not found in ANSTRUE).

5. Heim (1994) and strength from weakness

Both Karttunen's and Groenendijk & Stokhof's conclusions were based in large part on the properties of the verb *know* (and its relatives). Karttunen proposed that the set of propositions picked out (ANSTRUE) are exactly those that jointly constitute a true and complete answer to the question, which allowed him to define a lexical entry for *know* in a relatively intuitive way: When *know* takes a question, it is interpreted as being distributed among the propositions in ANSTRUE such that *know* holds of each. As pointed

out by Groenendijk & Stokhof, since none of the false propositions are in this set, *know* should entail no particular knowledge about these propositions (contrary to intuition). Karttunen explicitly accepted this, except in one special case: he did not want knowing who left to have no content when nobody, in fact, left. Instead, he proposed that in the special case where AnsTrue is empty, to know who left is to know this proposition: AnsTrue is empty.

Heim (1994) observes that if Karttunen's special case is generalized to all questions (not just those for which AnsTrue is empty), strong exhaustivity follows. Concretely, suppose that Quinn left alone, and therefore AnsTrue for *Who left?* is {*Quinn left*}. Heim's proposal is that to know who left in this case is to know this proposition: AnsTrue is {*Quinn left*}. This result mimics Groenendijk & Stokhof's very closely, yet adopting this revision of the definition of *know* allows Karttunen's semantics to remain essentially intact otherwise. It entails strong exhaustivity because if I know *Wade left* is not in AnsTrue, I can conclude that *Wade left* must be false (else, *Wade left* would have been in AnsTrue). We will use the label AnsExh for the proposition that AnsTrue is whatever it is, since this proposition is a close relative of Groenendijk & Stokhof's partition (leading to a strongly exhaustive answer).

This gives us two notions of "answer": the AnsTrue (weakly exhaustive answer), and the AnsExh (strongly exhaustive answer). Heim proposes that *know* is lexically specified to take the AnsExh of a complement question, explaining the strongly exhaustive nature of our intuitions. Heim also shows that although AnsExh can be derived from AnsTrue, AnsTrue cannot be retrieved from AnsExh—that is, AnsExh contains less information than AnsTrue. Thus, if there are cases for which AnsTrue is crucial in order to get the right interpretation, it is necessary that AnsTrue, and not AnsExh, is the basic representation of a question meaning.

Heim sketches some cases that arguably have this character. To give one example (also discussed by Berman 1991): when one is *surprised* who called, one seems to be surprised at the AnsTrue and not at the AnsExh. If I expect Pat, Tracy, and Chris to call, but only Pat and Tracy did, then I am not surprised who called; rather, I am surprised who didn't call. This distinction can be made in terms of AnsTrue, but cannot (by design) be made in terms of AnsExh.

6. *De dicto* readings, *de re* readings, and strong exhaustivity

Another argument that Groenendijk & Stokhof (1982) bring against Karttunen's (1977) semantics for questions has to do with the distinction between *de dicto* and *de re* interpretations (effectively 'what is said' and 'what is, really'). This distinction can be illustrated by considering the question *Which secret agents left?*. If Tom and Zoe are secret agents who left, Karttunen's

answer set (AnsTrue) will be {*Tom left*, *Zoe left*}. Importantly, nothing in those propositions indicates that they are secret agents. They *are* secret agents, which is how they got to be in the set, but this information is discarded once the set is built.

Karttunen's AnsTrue thus predicts that I can know which secret agents left, even if I cannot distinguish secret agents from ordinary civilians. All that should be necessary is that I know, for each of those who happen to be secret agents, that he/she left. This is the *de re* reading, which is admittedly somewhat difficult to perceive. Here is a scenario: Ellie (an uninformed civilian) throws a party and among the partygoers are Tom and Zoe, who subsequently left. Harry, head of the department, knows who the secret agents are and that several were at Ellie's party, and wants to know which secret agents left. He might consult Ellie, because *Ellie knows which secret agents left*, despite not knowing who the secret agents are.

Groenendijk & Stokhof point out there is a second (easier) reading for which part of what I know when I know which secret agents left is which people (at least among the leavers) are secret agents. This is the *de dicto* reading. For this reading, *I know which secret agents left* can be false even if *I know who left* is true. On this reading, in the scenario above, Ellie does not know which secret agents left, she only knows who left.

Groenendijk & Stokhof build the *de dicto* reading into their semantics (effectively, AnsExh): if I know that {*Tom left*, *Zoe left*} is the AnsTrue to *Which secret agents left?*, I can conclude that Tom and Zoe are secret agents.

Groenendijk & Stokhof's (and Heim's) analysis of questions embedded under *know* predicts that *de dicto* interpretations and strong exhaustivity necessarily go together: Both follow from knowing AnsExh; neither follows from knowing AnsTrue. Beck & Rullmann (1999), however, argue that it is possible to tease the two notions apart in certain cases.

As part of their argument, Beck & Rullmann focus on the verb *agree*, the truth conditions for which do not depend on truth in the actual world. For example, (1) could be true even if Jonas and Ida have no idea what constitutes Europe, so long as they each believe that the same set of countries (which happen actually to be in Europe) have a king. This would be the *de re* reading.

(1) Jonas and Ida agree on which European countries have a king.

(1) could also be true if Jonas and Ida are both wrong about what Europe is, so long as they are wrong together. For example, they might agree that Europia is a European country with a king and that no other country is either European or a monarchy. This is the *de dicto* reading, but the propositions they agree on are not true in the actual world.

Beck & Rullmann conclude from this that (1) does not show strong (or even weak) exhaustivity, on the

view that AnsTrue (and thus AnsExh) designates only propositions that are true in the actual world. On that basis, they propose a separate mechanism (essentially free assignment of world indices to nouns) to capture the *de re/de dicto* distinction.

Sharvit (2002) counters Beck & Rullmann's argument, noting that *agree* behaves in all other ways as if it were strongly exhaustive. For Pat and Tracy to agree on who cheated, they must also agree on who did not cheat—they must be able to divide everyone into the cheaters and the non-cheaters (see also Lahiri 1991, 2002). To say that *agree* is not strongly exhaustive simply because it does not rely on the truth in the actual world seems to miss this generalization. Instead, what seems to be special about *agree* is that a world other than the actual world can be designated as a reference world. The possible worlds are still partitioned in a strongly exhaustive manner, and Pat and Tracy have the same (perhaps mistaken) belief about which compartment of the partition the reference world is in.

Sharvit goes on to argue that *de dicto* readings and strong exhaustivity really do go together after all. In doing so, she argues that predicates can be divided into two classes, those that allow (or even prefer) to be interpreted with AnsExh (e.g., *know*, *agree*), and those that only allow interpretation with AnsTrue (e.g., *surprise*). The latter type can never be interpreted via AnsExh, and as a result cannot take on a *de dicto* reading. The judgments and scenarios required to show this are very complex and delicate; interested readers are referred to Sharvit (2002) for further explication.

7. Quantificational variability

Berman (1991) observed that quantificational adverbs seem to be able to quantify over some part of an embedded question (2–3), an effect that he called "quantificational variability" (QV, or QVE), after a seemingly similar effect seen with indefinites (4–5). This phenomenon has generated interest in the literature because it appears to provide an empirical window onto the parts out of which questions are built.

(2) Sue mostly remembers what she got for her birthday.
(3) The complaint listed, in part, which files I downloaded.
(4) A student usually watches TV.
(5) A student rarely watches CNN.

Indefinites show quantificational variability in the sense that a *student* in (4) could be paraphrased using *most students*, while the same indefinite in (5) would be paraphrased using *few students*. This variability has been taken as evidence (Kamp 1981, Heim 1982) that indefinites have no quantificational force of their own, and are instead (restricted) variables, bound by quantificational adverbs in the vicinity (or, failing that, by a default existential quantification). Berman

proposes that (2–3) can be accounted for in a similar way, interpreting *wh*-phrases as (restricted) variables bound by a quantificational adverb in the vicinity (see also Nishigauchi 1990 for a similar view).

Not every embedding verb permits QV. Verbs like *discover* and *know* do, but verbs like *wonder* appear not to (6).

(6) #The principal mostly wonders which students cheat on the final exam.

Berman proposed that factivity is what distinguishes verbs that permit QV from those that do not. Specifically, for verbs that presuppose their complement (like *know*), a form of presupposition accommodation places the question in the restriction of the quantificational adverb, such that (2) comes to mean 'for most things *x* such that Sue got *x* for her birthday, Sue remembers that she got *x* for her birthday.'

For Berman, a question is semantically an "open sentence," a proposition with an unbound variable within it (a view traceable to Hintikka 1976). Since it is a proposition, verbs that take propositions should take open sentences and verbs that presuppose their complements should show QV effects with a question complement. However, Lahiri (1991, 2000, 2002) provides several arguments against this conclusion. First, not all factives can embed interrogatives (*regret*, for example), surprising if interrogatives are essentially the same semantic type as propositions. Second, some non-factive verbs nevertheless show QV effects. One example is *tell*, which is not factive when it embeds statements, but seems to become factive (and show QV effects) when embedding interrogatives (as both Baker 1968 and Berman 1991 note). Third, verbs like *agree* are not factive with either statements or interrogatives, yet show QV effects (7).

(7) Pat and Tracy agree, for the most part, about who they saw at the party.

Lahiri proposes an alternative analysis under which the QV effect arises not from the factivity of the embedding verb, but rather from the repair of a semantic type mismatch. A verb like *know* operates on propositions, and a question is not of the correct semantic type (for Lahiri, a question is a set of propositions). This mismatch can be resolved in the same manner that type mismatches are resolved with object quantifiers: the embedded question undergoes a form of QR ("Interrogative Raising") into a position in the syntactic structure appropriate for restricting the quantificational adverb, leaving behind a "propositional variable" (now of the right type to serve as an argument of *know*).

Berman's and Lahiri's analyses differ in what is actually being quantified over by the adverb. For Berman, the quantification is over individuals (e.g., the presents Sue received in (2)), while for Lahiri, the quantification is over propositions that form parts of the answer to the question (where a "part" of an answer, to a reasonable approximation, is any proposition or conjunction of propositions from AnsTrue).

See Lahiri (2002) for some discussion of how these might be distinguished empirically.

Sharvit & Beck (2001) take a rather distinct third view on QV, proposing that quantificational adverbs are quantifying over "subquestions." A question qualifies as a subquestion of another question Q if its AnsExh implies a partial answer to Q. For example, subquestions of *Who cheated?*, in a context where Pat and Chris are the relevant individuals, might be *Did Pat cheat?* and *Did Chris cheat?*. With quantificational adverbs quantifying over subquestions (which are questions in their own right), it is necessary to suppose that QV effects arise with question-embedding predicates and not with statement-embedding predicates, completely the reverse of the usual generalization. In support of their version of the generalization, Sharvit & Beck point out that verbs like *depend* (8) and generic *decide* (9) both show QV, yet cannot themselves take propositional complements. Further, although it is generally impossible to get a QV effect with *wonder* (6), the addition of adverbs like *even* or *still* can make QV with other question-embedding verbs palatable (10–11). On Sharvit & Beck's analysis, the lack of QV behavior with *wonder* is treated as exceptional, requiring some separate explanation.

(8)   Which candidates will be admitted depends, for the most part, on this committee.
(9)   The admissions committee decides, for the most part, which candidates will be admitted.
(10) For the most part, they didn't even *ask* who was over 21.
(11) For the most part, he is still wondering which students cheated.

Berman's and Lahiri's analyses of QV depend on the ability to look inside a question denotation in some way, something that is relatively achievable if a question is a complex object formed from more basic propositions. On the other hand, their analysis does not, on the face of it, mesh well with Groenendijk & Stokhof's view that a question is represented by its true and exhaustively complete answer.

Groenendijk & Stokhof (1993) take up this challenge, presenting an analysis of QV effects in a dynamic semantic framework, and managing to accommodate the essential features of Berman's empirical results. Their system, like Berman's, takes QV effects to arise from quantification over individuals, but they do show that QV effects are not beyond the reach of their general partition view when enriched with the tools of dynamic semantics.

8. Focus
It has long been thought that the semantics of questions and the semantics of focus (particularly, contrastive focus) are intimately related. A sentence with a focused constituent (12) seems to evoke in some way the question formed with a *wh*-word in place of the focus (13). That is, the same things that would have served as possible answers to the question seem to be those things that are being contrasted under focus.

(12) I (only) bought a LAMP for Tracy.
(13) What did you buy for Tracy?

Additionally, focus and *wh*-words in situ share the syntactic property of being relatively free from island constraints.

Rooth (1985) developed an influential semantics for focus that turns out to be nearly identical to Hamblin's (1973) semantics for questions. In Rooth's system, a focus marked constituent triggers the existence of a nontrivial "alternative set" that is available for use by certain focus sensitive operators (like *only*). This alternative set for a sentence with a focus marked constituent is basically AnsPoss, Hamblin's set of possible answers to the parallel question.

To the extent that it is correct to draw this parallel between focus and question semantics, this can serve as an indirect argument in favor of a Hamblin-style proposition-set semantics for questions, as well. That is, if the mechanism to create AnsPoss is needed anyway for focus, a tighter theory would use it for questions also. Interpreting contrastive focus is really about comparing alternatives, and AnsPoss provides a ready-made set of comparable alternatives, but extra machinery would be necessary to enable conversion from a question partition to a useable set of alternatives for focus. In this connection, it is worth pointing out that AnsPoss is also preferable to AnsTrue; limiting the comparison set to only the true propositions makes little sense in the context of focus interpretation—for focus, all relevant alternatives, true or not, should be in the comparison set.

9. Relating the semantics of questions to their syntax
So far we have had little to say about the syntax of questions, which might seem reasonable, given that this is an article about the semantics of questions. However, the focus of much recent work on question semantics has been on the connection between the syntax and semantics, where each constrains the other. The assumption is that the syntactic structure and the semantic structure should match to the greatest degree possible, to the extent that the semantics should be able to be "read off" the ultimate syntactic structure (LF).

It is well known that languages differ in how they treat their *wh*-words. English *wh*-questions require movement of one *wh*-word to a clause-initial position, Bulgarian requires *wh*-movement of all *wh*-words to a clause-initial position, Japanese need move no *wh*-words at all, and various more nuanced options exist as well. It has long been thought that *wh*-movement is a syntactic solution to a semantic problem: for a *wh*-word to be interpretable, it must be split across two positions (just as a quantifier must), one serving as the operator and the other as the variable (e.g., '**For which** x is it the case that Pat bought x?'). The implication of this hypothesis is that,

whether we hear them moving or not, all *wh*-words must move to create this operator-variable structure by the point of interpretation.

There has always been an irritating thorn in the side of this hypothesis, however: Many *wh*-words that do not move overtly seem to be immune to a basic property of movement: the constraint against escaping syntactic islands. Faced with this, there are basically two options. One is to suppose that covert movement is simply privileged in its ability to cross island boundaries (Huang 1982); another is to abandon the movement hypothesis and suppose that *wh*-in-situ can be interpreted in place without movement.

In other domains, evidence has since accumulated that covert movement does seem to be constrained by islands (and, in fact, movement of quantifiers seems to be constrained even more tightly, unable to escape a tensed clause); see, e.g., Reinhart (1997) for a recent discussion. Accordingly, much current research has been devoted to the exploration of different means by which a *wh*-in-situ can be interpreted without movement.

In this connection, a parallel is often drawn to indefinites like *someone* or *a student*. These, too, have long been known to have the same irritating property of taking scope higher than we would predict (that is, higher than other quantifiers, e.g., *everyone*, can). The hope is that the explanation of the behavior of indefinites can at the same time serve as an explanation of *wh*-in-situ.

It is worth a passing mention here that *wh*-phrases seem to fall into two classes, those that exhibit the island-insensitivity property (e.g., *who*, *what*), and those that appear to respect islands even when not overtly moved (e.g., *why*, *how*). Although we will not focus on this further here, the accounts described below, under which a *wh*-in-situ remains in situ, are still responsible for explaining the behavior of this second class (for example, through restrictions on the semantic type of *wh*-phrases that can be interpreted in situ).

9.1 LF pied piping

One attempt to maintain both the idea that *wh*-movement is necessary for interpretation and the idea that covert movement is constrained by syntactic islands has been to suppose that when a *wh*-word is inside an island, the *wh*-word does not itself move to its scope position (SpecCP) but rather that the "*wh*-hood" of the *wh*-phrase percolates in some manner to the entire island, which moves instead (see in particular Nishigauchi 1990 for detailed elaboration). This is a fairly direct analogy to what happens with overt *wh*-movement in cases like (14), where the entire phrase *whose book* has moved to SpecCP (although only *who* is a *wh*-word).

(14) Whose book did you borrow?

This example can serve not only to illustrate the idea behind pied piping for interpretation, but also the difficulty it faces. Notice that the interpretation one would predict from (14) is something like (15), yet this is not correct. As von Stechow (1996) shows, in order for this to be interpreted as a question about people and not about books (16), it is still necessary to extract the *wh*-word from the island (and reconstruct the non-*wh* parts of the island), undermining one of the basic motivations for an "LF pied piping" view.

(15) *For whose book x: You borrowed x.
(16) For which person x: You borrowed x's book.

9.2 Interpreting *wh*-phrases in situ

Wh-movement is assumed to create a binding relation between the moved operator and its trace, but it is the movement, and not the binding relation itself, that is sensitive to islands. A binding relation can be established without movement (and thus predicting no interference by islands) by positing two syntactic objects, one serving as the operator and the other serving as its variable. This is often referred to as "unselective binding," in reference to the fact that the binding relation is established not through movement but by fortuitous assignment of indices linking the operator to its variable(s).

Baker (1970) was one of the earliest proponents of such a view, proposing that questions contain a Q morpheme in Comp that is coindexed with as many *wh*-words as it is associated with. Pesetsky (1987) took up this proposal as well (although limiting it to the binding of a special class of *wh*-words, those that are more heavily dependent on a fixed set of referents in the discourse).

Reinhart (1998) argues that at least a simple implementation of unselective binding cannot be quite right, presenting the now-famous question in (17). The idea is this: we have a *wh*-word in situ inside a well-established island (an *if*-clause). If we leave the *wh*-phrase there and interpret it as unselectively bound by Q, we arrive at something like (18).

(17) Who will be offended if we invite which philosopher?
(18) *For which x, y: if we invite y and y is a philosopher, x will be offended.

The problem with (18) is that its answerhood conditions are too easily satisfied. The question (17) *should* pick out the propositions that pair the potentially offended with philosophers. The interpretation in (18), however, gives inviting x the same status as x being a philosopher at all, the result being that the propositions picked out are not only those implementing the pairings just mentioned, but also pairings of the potentially offended with any non-philosopher (invited or not). It is as if the question were *Who will be offended if who is either invited or a philosopher?*. Reinhart gives (19) as an example of a possible answer (18) admits, and for this reason this whole issue is sometimes referred to as the "Donald Duck problem."

(19) Lucie will be offended if we invite Donald Duck.

The Donald Duck problem stems from the fact that the restriction of *which philosopher* (i.e. *philosopher*) is interpreted within the *if*-clause. If we instead suppose that *wh*-movement occurs covertly, free from island constraints, the problem disappears (20); the restriction to philosophers is no longer interpreted inside the *if*-clause, and the answerhood conditions are appropriate.

(20) For which x, y, y a philosopher: if we invite y, x will be offended.

Thus, there is a tension between maintaining an elegant syntactic account (where movement is uniformly constrained by islands), on the one hand, and having a working semantics, on the other. Reinhart proposes a solution to this problem (using choice functions), to which we will return after considering some alternatives.

Rullmann & Beck (1998a, b) and Cresti (1998) pursue a presuppositional solution to the Donald Duck problem, incorporating the idea that *wh*-phrases presuppose their descriptive content. Effectively, under Rullmann & Beck's version of this proposal, (17) comes out to something like (21).

(21) For which x, y: if we invite the philosopher y, x will be offended.

The idea here is that *the philosopher y* presupposes that y is a philosopher, and that a proposition containing *the philosopher y* in a possible world in which y is not a philosopher would be neither true nor false but simply undefined. This effectively removes the non-philosophers from the propositions picked out by (17), and with certain technical assumptions yields appropriate answerhood conditions.

Rullmann & Beck go further, arguing that *wh*-phrases *must* be interpreted in situ. Their argument revolves around the "projection" properties of the presuppositions of *which*-phrases, which seem to show that regardless of where the *which*-phrase appears on the surface, its presuppositions are projected from its base position.

Their argument is based on the presuppositions of questions like (22). They observe that to felicitously utter (22), the speaker need not commit to the existence of space aliens, but only to the proposition that Bill does—as compared to (23), where the speaker indeed must commit to the existence of space aliens.

(22) Which space alien does Bill want to catch?
(23) Which space alien does Bill know he caught?

This is a general property of presupposition projection (Heim 1992, Karttunen 1974), as can be seen from (24–25). When a presupposition is embedded in the complement of *want*, it is projected to the higher clause as a presupposition about the wanter's beliefs, whereas when a presupposition is embedded in the complement of *know*, it becomes a presupposition of the entire higher clause. Rullmann & Beck point out

that the behavior of (22–23) with respect to presuppositions indicates that the presupposition of *which space alien* is evaluated in the embedded clause (despite its surface position).

(24) Bill wants to catch the blue space alien.
(25) Bill knows he caught the blue space alien.

Reinhart (1998) rejects a presuppositional solution to the Donald Duck problem, on the grounds that the properties of (17) do not significantly change if *which philosopher* is replaced by *what philosopher*, yet it is generally thought that *which*-phrases are presuppositional while *what*-phrases are not. Cresti (1998) (attributing the suggestion to Sigrid Beck) speculates that the presuppositional hypothesis might nevertheless be viable if we suppose that *what*-phrases carry a presupposition about kinds, and not about individuals. The issue remains open.

Questions like those in (26–27) have also been offered in favor of interpreting *wh*-phrases in situ, *wh*-questions that have a *wh*-word contained within another *wh*-phrase.

(26) Which mountain in which country did you climb?
(27) Which relative of which child attended the picnic?

These questions pose a problem similar to that encountered in the previous section with "LF pied piping": Unless the internal *wh*-phrase can be extracted from the containing *wh*-phrase, there would be only a single trace of *wh*-movement—a single variable—and (26) should come out meaning the same thing as 'Which mountain did you climb?' (see also von Stechow 2000, Cresti 1998, Sternefeld 2001, Sauerland & Heck 2003). If the moved *wh*-phrase is reconstructed and interpreted in its base position, however, the interpretation of such questions is relatively straightforward, picking out propositions that pair mountains and countries. An unselective binding analysis would have no difficulty providing such an interpretation, and Sauerland & Heck (2003) show that such questions can be analyzed along the lines of (21) as well.

9.3 Alternative semantics
A different approach to the general island insensitivity of *wh*-in-situ that has been explored recently returns to Hamblin's (1973) view, under which the *wh*-phrase does not have a binder *per se*, but instead contributes its set-hood directly in the process of composition. In essence, the way this system works is that a *wh*-word like *who* is taken to denote a set of individuals. While normally a predicate like *leave* would take an individual as its argument (e.g., *Pat left* will be true if *leave* assigns TRUE to Pat), in a question like *Who left?*, *leave* is predicated of a **set** of individuals. The composition rules apply *leave* to each member of that set, generating a corresponding set of propositions, one for each individual in the *who* set.

Carrying this through results in the AnsPoss set, those propositions that can serve as answers to *Who left?*. This kind of compositional system takes no notice of island boundaries, since movement is not involved, and so there is nothing that would prevent *wh*-words within islands from generating questions.

Analyses in terms of alternative semantics have been explored by, e.g., Hagstrom (1998), Shimoyama (2001), and Sternefeld (2001), as an alternative to Nishigauchi's (1990) LF pied-piping proposal for Japanese, and extended to explain subtle aspects of the meaning of the German indefinite *irgenwen* 'someone (I don't care who)' by Kratzer & Shimoyama (2002).

9.4 Choice functions

The final approach to *wh*-in-situ we will consider here, choice functions, provides a way to implement something like unselective binding (allowing the *wh*-phrase to stay in place), while at the same time preventing the restrictor from causing the Donald Duck problem. The centerpiece of this approach is the **choice function**, a function that, when provided a set from which to make a choice, chooses one element. Although choice functions have appeared sporadically in both the philosophical and semantic literature, they have most recently been popularized by Reinhart (1997, 1998), as a solution to the scope freedom both of indefinites and of *wh*-in-situ (see also Engdahl's 1980 ''selection functions'', as well as Winter 1997, Kratzer 1998, Matthewson 1999, Romero 1999).

The translation of (17) using a choice function would be something like (28) (Reinhart 1998), where *f* can be thought of in prose as 'a way to choose' and *f*(philosopher) is a choice from among the philosophers.

(28) For which x, f: We invite f(philosopher) $\rightarrow x$ will be offended.

This yields the right results; the only ones considered in the antecedent of the conditional are the philosophers, and assuming that the choice function in the conditional is treated as a variable bound higher up by a separate quantifier, no movement was necessary.

10. Questions with quantifiers

The properties of questions with quantifiers, such as (29), have generated a great deal of discussion (see, e.g., Szabolcsi 1997 for a recent overview). The first observation to make about them is that they seem to have several distinct readings, as diagnosed by the answers they can receive: a single answer (30), a list answer (31), or a functional answer (32). The nature of the quantifier in a question matters, as well; a question like (33) does not admit a paired answer, but allows single and functional answers.

(29) Which drink did everyone buy?
(30) (Everyone bought) coffee.

(31) Pat bought coffee, Chris bought milk, Tracy bought beer, …
(32) Everyone bought his/her favorite drink.
(33) What ice-cream flavor does nobody like?
(34) (Nobody likes) sausage.
(35) #... (*silence, listing for no person what he/she likes*)…
(36) Nobody likes his/her parents' favorite.

Intuitively, the difference between the paired answer and the single answer seems like a scope difference—e.g., *Tell me the x such that for every person y, y bought x* vs. *For every person y, tell me the x such that y bought x*. Technically, however, there are difficulties that arise if *everyone* is allowed to quantify into a question (see, for example, Chierchia 1993 for discussion). Primarily, the problem is that *everyone* is defined in terms of propositions, and to allow it to operate on questions would require either extending the rules of composition or, worse, defining a special version of *everyone* specifically to quantify into questions. Further, if such quantification is allowed in general, it is not clear how to constrain it to avoid the nonexistent reading of (33).

The functional reading of (29) exemplified by the answer in (32) asks something like *what is function f mapping people to things such that every person y bought f(y)*? It is actually something like the single answer, except requesting a function instead of an individual. These readings were first discussed by Engdahl (1980, 1986) and Groenendijk & Stokhof (1983/1984).

The syntactic configuration of these questions affects the availability of the three readings as well. May (1985) observes that if the *wh*-word originates higher than the quantifier does (37), the list reading is unavailable. Moreover, the functional answer is unavailable as well—in fact, it's basically ungrammatical (a Weak Crossover violation), not just infelicitous.

(37) Which student brought everything?
(38) Pat brought everything.
(39) #Pat brought the salad, Chris brought the sausages, Tracy brought the plates, ...
(40) *Its$_i$ most enthusiastic proponent brought everything$_i$.

Szabolcsi (1997) argues for a further distinction between matrix questions and embedded intensional questions, on the one hand, and embedded extensional questions, on the other. More quantifiers permit list readings in the latter type of question than in the former type. For example, *more than two dogs* can only evoke a list reading in the latter type (43) (the grammaticality markings in 41–43 pertain only to the list reading), while a quantifier like *every dog* would permit a list reading for all three.

(41) *Who did more than two dogs bite?
(42) ??John wonders who more than two dogs bit.
(43) John discovered who more than two dogs bit.

10.1 Plurality

Before proceeding further, it should be noted that consideration of plurals is important when evaluating the predictions of, and constraints on, analyses of the availability of the different readings (particularly the list reading). Pritchett (1990), and before him Kuno & Robinson (1972), observed that the questions in (44–45) seem to have list readings quite parallel to that available in (29).

(44) What did the boys rent last night?
(45) Who rented the movies last night?

This is problematic for an analysis of the list reading as a quantifier scope phenomenon, since these questions have no quantifier. Krifka (1992) argues, however, that in these cases, the ''list reading'' is of a different sort. Rather than being truly distributive, the list answers to (44–45) are really ''over-informative'' answers. The answer to, e.g., (44) would be the plurality of movies rented by the boys (a single answer), but a list—although not actually requested—serves to clarify the mapping from boys to movies. In support of this view, Dayal (1996) observes that (44–45) also lack a functional reading.

Chierchia (1993) points out that some *wh*-words, e.g., *who*, are ambiguous between a singular and plural interpretation, and can therefore appear to admit more readings than predicted, due to the availability of the kind of ''over-informative'' answers available for plural single answers. Plurality introduces several complexities—and, of course, even outside the domain of question semantics, there is some debate as to how plurality should properly be modeled (see, e.g., Preuss 2001, Agüero-Bautista 2000a for extended discussion of these issues).

10.2 Lists as functions

Chierchia (1991, 1993) observes that the ungrammaticality of (40) is a canonical case of a Weak Crossover (WCO) violation: for *everything* to bind *its*, QR must carry *everything* to a higher position in the structure, crossing over the coindexed pronoun. Chierchia (1991) proposes that the missing list reading in (39) is also ruled out by WCO, hypothesizing that the list reading itself relies on a kind of functional relationship between the quantifier and the base position of the *wh*-word.

The idea that a list answer is a form of functional answer is, at least on the face of it, reasonable. The function in a functional answer is, after all, a means of pairing individuals, and the list answer can be viewed, in this light, as specifying the function by listing the pairs (its extension) (see also Engdahl 1980, 1986). If a list answer is a special case of a functional answer, and the functional answer is, in turn, basically like a single answer (but over functions instead of, say, individuals), then there is no further need to allow ''quantification into questions,'' since all the quantifier need take scope over is the *wh*-trace.

Still, there are cases in which a functional answer is possible but a list answer is not (35–36), so there must be something distinguishing the two readings. Chierchia proposes that the list reading relies on the quantifier to provide a ''minimal witness set'' to set the domain for the list (see also Higginbotham 1993, Groenendijk & Stokhof 1984). While quantifiers like *everyone* provide this (the smallest set that can ''witness'' *everyone* is the set of all the relevant people), quantifiers like *nobody* and *at most two people* do not (the smallest set that can ''witness'' *nobody* or *at most two people* has no members). Chierchia (1993) revises his earlier analysis somewhat, proposing that the list reading arises from a more complex process of ''Absorption'' between the quantifier and *wh*-phrase (borrowing ideas from Higginbotham & May 1981) to solve some technical problems, but the basics of the analyses for our purposes are the same.

On Chierchia's account, the appearance that the quantifier has outscoped the *wh*-phrase arises from the quantifier binding a pronominal element at the *wh*-trace (thus bringing the structure under the purview of Weak Crossover). Agüero-Bautista (2000b) argues on the basis of Principle C effects that in fact the entire restriction from the *wh*-phrase must be interpreted in the scope of the quantifier (reconstructing if needed) in order to get a list reading: When the restriction is prohibited by Principle C from reconstructing, no list reading is available. In (46), the restriction of the *which*-phrase cannot be interpreted in its base position because *Pat Riley* would be illegally bound by *he*, and as predicted, (46) has no list reading. In (47), on the other hand, reconstruction is possible, and the list reading returns.

(46) Which player on Pat Riley's team did he award each prize to?
(47) Which player on his team did Pat Riley award each prize to?

The facts discussed in this section imply that the availability of the list reading depends on the scope options open to the *wh*-phrase, rather than those open to the quantifier, weakening the case for a need to quantify into questions.

10.3 Quantifying into questions

Not everyone treats quantification into questions as problematic. For example, Groenendijk & Stokhof (1984) have no technical difficulty with this, since for them, the semantic type of a question is the same as that of a proposition (hence the main objection to quantifying into questions does not hold).

Krifka (2001) also proposes an analysis using a form of quantification into questions (with its roots in a proposal made by Karttunen 1977), suggesting that an abstract ''question speech act'' should be included in the semantic representation, over which quantifiers can take scope. The catch—effectively limiting the quantifiers that can outscope question acts to universals—is that speech acts can only be conjoined (not

disjoined or negated). The limitation on quantifiers follows because, while universal quantifiers like *everyone* can be viewed as a kind of generalized conjunction, all other quantifiers can only be formulated with the help of disjunction or negation; thus, only universal quantifiers can be interpreted outside a question act. For embedded questions, Krifka maintains a speech-act analysis for questions embedded under intensional verbs (like *wonder*), but for questions embedded under extensional verbs (like *find out*), he advocates a shift to a plurality of the true answers, allowing non-universal quantifiers to generate list readings (43).

Moltmann & Szabolcsi (1994) present an intricate argument for quantification into questions based on the behavior of quantifiers within embedded questions. Although we cannot review the technical details that led them to that conclusion here, the phenomenon they observe is worth some discussion. Moltmann & Szabolcsi observe that a quantifier embedded within an extensional question seems to be able to take scope over a quantifier in the higher clause. Specifically, (48) has an interpretation where for each boy there is a possibly distinct librarian, a reading that is not available for a quantifier embedded in a declarative clause (49) or in an intensional question (50). The availability of the librarians-vary-with-the-boys reading in (48) is surprising because under normal circumstances (49–50), quantifiers cannot extend their influence beyond the tensed clause in which they appear.

(48) Some librarian or other found out which book every boy needed.

(49) Some librarian or other told me that every boy needed *The Grapes of Wrath.*

(50) Some librarian or other wondered which book every boy needed.

Furthermore, this reading disappears if a pronoun bound by the matrix quantifier is introduced into the lower clause (51). This is unexpected if the librarians-vary-with-the-boys reading comes about through a kind of "long QR" of the embedded quantifier *every boy*, since the relation between *more than one librarian* and the bound pronoun should have no bearing on such an operation.

(51) More than one librarian found out which book every boy stole from her.

To account for these facts, Moltmann & Szabolcsi propose that the librarians-vary-with-the-boys reading of (48) arises not from QR of *every boy*, but rather from QR of the entire embedded question to a position higher than the main clause quantifier. Specifically, the embedded question "inherits" the quantificational properties of *every*, becoming a quantifier itself (in certain respects reminiscent of the LF pied piping proposal discussed above in section 9.1). This question-turned-quantifier obeys the constraints on QR; it cannot take scope out of a tensed clause that contains it, thus (52) lacks the librarians-vary-with-the-boys reading. This reading is also missing from (51), for the simple reason that the question-turned-

quantifier must be outscoped by *more than one librarian* in order for *her* to be bound. As for what allows the question to perform properly as a quantifier, Moltmann & Szabolcsi argue that quantification into questions is required.

(52) Some librarian or other thinks I found out which book every boy needed.

Higginbotham (1993) presents an account of questions with quantifiers, in part building on an analysis of "choice questions" like (53), which have a reading that can be paraphrased as 'pick two screwdrivers and answer this question about each: where is it?'. Higginbotham proposes that questions with quantifiers induce a structure of "blocs", each bloc being a set of questions defined by a witness set for the quantifier. The idea is that for each choice of two screwdrivers (a witness set for *two screwdrivers*), a bloc containing the two questions about their location is formed, and to successfully answer the question is to answer all of the questions in one of the blocs. For questions with a universal quantifier, there is only one witness set, and so there is only one bloc available to answer.

(53) Where can I find two screwdrivers?

Whether this is properly called "quantification into questions" is debatable. As Chierchia (1993) points out, although it involves quantification and questions, it still requires a rather different mechanism from that used for standard quantification into statements.

Pafel (1999) outlines an analysis that draws a parallel between questions and definite descriptions, and attempts to leverage existing results about plurals and kinds in the nominal domain to understand questions in terms of singular propositions, plural propositions, and kinds of (plural) propositions. As part of his analysis, he proposes a way of treating the interaction between *wh*-words and quantifiers in the same way as the interaction between any two quantifiers. Under Pafel's proposal, the type problem that arises under other quantifying-in analyses is avoided by splitting up the contribution of the interrogative quantifier in such a way that a raised quantifier can take scope over a *wh*-word without taking scope over the question as a whole. While Pafel's specific proposal (too complex to be substantively reviewed here) provides a coherent synthesis of many of the properties of questions with quantifiers discussed in the literature to date, it comes at the cost of admitting a fairly elaborate system of covert elements inserted at LF for interpretability. It will be interesting to see in what way the connection with pluralities and kinds in the nominal domain is developed in future research (see also Preuss 2001 for a partially similar account and discussion).

11. Multiple *wh*-questions

In most languages it is possible to form a question with more than one *wh*-word (54). Usually, the answer to such questions takes the form of a list (55), although

under certain conditions multiple *wh*-questions seem to be only felicitous as requests for a single pair. As Garrett (1996) and Dayal (2002) independently observe, when one of the *wh*-words is inside a movement island, a list reading is precluded. For example, while (56) has a list reading, (57), with a *wh*-phrase inside a complex noun phrase, seems to permit only a single pair answer.

(54) Which philosopher likes which linguist?
(55) John likes Mary, Sue likes Bill, and Pat likes Tracy.
(56) Who bought what for Max?
(57) Who wrote a report that Max bought what?

Barss (2000), Dayal (2002), and Hagstrom (1998) use evidence of this sort to argue for the existence of two independent mechanisms for interpreting *wh*-in-situ, one that yields list readings but relies on movement, and another that does not rely on movement but yields only single pair readings. For Barss, list readings arise through a process of Absorption between the *wh*-phrases, and for Dayal, list readings arise through movement of the *wh*-in-situ to fix the range of a function, but both require (sometimes covert) movement of the *wh*-phrases into a structurally high scope position. For *wh*-phrases trapped within an island, this movement is impossible (ruling out a list reading), and Barss and Dayal both call upon choice functions (recall section 9.4) to interpret the *wh*-word in situ.

The approach taken by Hagstrom (1998) also relies on choice functions to differentiate list readings from single-pair readings, although in a rather different way. Under that proposal—designed to account for the loss of list readings in island-less multiple *wh*-questions in *wh*-in-situ languages—the contribution of the choice function is responsible for the *list* reading, and its absence (or structural irrelevance) is what leads to the single-pair reading.

Although (56–57) indicates that a *wh*-in-situ inside an island cannot participate in a list reading, there is a well-known exception concerning *wh*-islands. Baker (1970) observed that questions such as (58) allow a list reading that pairs the matrix subject and the embedded object (59). Dayal (1996) notes that such readings only appear when the higher *wh*-word is in the same clause as an embedded multiple question (a configuration she calls the "*wh*-triangle"); the list reading disappears when an intermediate clause separates them (60).

(58) Which student knows where Mary bought which book?

(59) Pat knows where Mary bought *Aspects*, and Tracy remembers where she bought *Barriers*.
(60) Which student said that John knows where Mary bought which book?

Dayal (1996) proposes that the list reading of (58) arises not from movement of the embedded *wh*-word in this case, but rather from QR of the entire embedded question into the main clause (abstractly similar to Moltmann & Szabolcsi's analysis of (48) and Lahiri's and Sharvit & Beck's analyses of QV effects).

12. Concluding comments

So, where does this leave us? Questions in some sense specify the form that an answer will take, picking out a set of propositions that bear some relation to the answer. This could be a Groenendijk & Stokhof-style proposition that induces a partition that picks out exhaustive, complete, and mutually exclusive answers to the question, or it could be a Hamblin (1973)-style set of propositions, or a Karttunen-style subset of the true answers, or a Lahiri-style closure under sum of a Hamblin-style set, or a Hintikka/Berman-style open sentence. We've seen a number of ways in which one view seems to have advantages over another, as well as ways of transcoding them. As far as the subfield as a whole is concerned, the jury is probably still out. In the part of the subfield we have concentrated on here (and probably also that part closest to the research circles of the *Glot International* readership), the dominant view leans more toward a Hamblin- or Lahiri-style representation of questions as sets of possible answers in some form, with a Karttunen-style compositional structure. Augmented with Heim's (1994) methods of moving between ANSPOSS, ANSTRUE, and ANSEXH, many of the results obtained under a partition view can be accommodated within a Hamblin-style semantics. Concerning the interface with syntax, many working from a semantic vantage point have come to the conclusion that *wh*-phrases can, or even must, be interpreted in their base positions, regardless of their surface positions. We have also looked briefly at some of the more complex issues involved in questions with quantifiers and multiple *wh*-questions, where many questions remain open.

In this very short review, we have only touched on the broadest issues from a small subset of the literature, but have perhaps managed to get a bird's-eye view of significant portions of the current theoretical landscape.

A semantics of questions bibliography

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