Consider the set of \textbf{possible worlds}.
In possible world $w_1$, $A_1$ is the true answer to the question $Q$.
In possible world $w_2$, $A_2$ is the true answer to the question $Q$.

Assuming that: \text{In any given world $w_n$, exactly one answer $A_m$ is true.}

We can partition possible worlds by which answer is true in that world.

\textit{Did John leave?}

\begin{center}
\begin{tabular}{|c|c|}
\hline
\textbf{Yes} & \textbf{No} \\
(John left) & (John didn’t leave) \\
\hline
\end{tabular}
\end{center}

\text{John left} is true in the worlds over here.  \text{John didn’t leave} is true in the worlds over here.

The question \textit{Did John leave?} then asks
\textit{Which of the two cells of the partition is the real world in?}

or

\textit{Is the real world such that John left or is it such that John didn’t leave?}

(8) \text{Have you stopped stealing office supplies?}

\textbf{Postulates (Hamblin 1958)}:
\begin{itemize}
\item[I.] An answer to a question is a statement.
\item[II.] Knowing what counts as an answer is equivalent to knowing the question.
\item[III.] The possible answers to a question are an exhaustive set of mutually exclusive possibilities.
**Truth and Meaning:** Suppose that knowing the meaning of S is equivalent to knowing the conditions under which S is true.

We can partition possible worlds by which answer is true in that world.

**Who left?**

<table>
<thead>
<tr>
<th>John and Mary left</th>
<th>Mary left</th>
</tr>
</thead>
<tbody>
<tr>
<td>John left</td>
<td>neither John nor Mary left</td>
</tr>
</tbody>
</table>

Possible answers are *mutually exclusive* under this model.

Another possibility: allow *John left* and *Mary left* as possible answers (where either, both, or neither could be true, and could be provided when answering the question). This one is a little easier.

**Who left?**

<table>
<thead>
<tr>
<th>John left</th>
<th>Mary left</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

There actually has been quite a bit of debate in the literature between these two models. We’re better equipped to handle the second one until we talk about plurals (like *John and Mary*).

On the second one, the semantics of *Who left?* is purported to be

(9)  $\Box p.\Box x.\Box p = \Box y. x \text{ left in } w.$

**A couple of classic approaches (Hamblin 1973, Karttunen 1977)**


(10)  Who left?

The set is like \{John left, Mary left, Bill left, Sue left, \ldots\} i.e. contains $x$ left for $x$ people.
Hamblin makes the following suggestions:

Although we are inclined to class ‘who’ and ‘what’ with proper names we cannot by any stretch regard them as denoting individuals. But there is a simple alternative: they can be regarded as denoting sets of individuals, namely the set of humans and the set of non-humans respectively. (48)

This does not mean, of course, that the formula ‘who walks’ asserts that the set of human individuals walks: we must modify other stipulations in sympathy. We shall need to regard ‘who walks’ as itself denoting a set, namely, the set whose members are the propositions denoted by ‘Mary walks’, ‘John walks’, … and so on for all individuals. (48)

So what do we do? Consider a “real life” analogy:

Suppose we think of a vending machine as a function — a function that given a quarter returns a gumball.

What if you arrive with a bag of quarters?
The machine does not bags… it takes quarters.

This suggests a natural way of looking at this: (it’s a lot like mapcar)

• You have a function that can apply to individuals
• You have a set of individuals

so
• Apply the function to each individual in the set (separately).
• When you are done, you have a set of results (instead of just one).

We can refer to this as flexible functional application. (see also Rooth 1985, Rullmann & Beck 1997)

The idea is that if you just make a set of people the argument, since walks is only a function from (single, atomic) people to truth conditions, you apply walks to each person in the set.

This gives you the set \{John left, Mary left, Bill left, Sue left, …\} but without any explicit operator-variable structure in the syntax. In fact, he points out:

Although standard English word-order places the interrogative word or phrase (or the main one, if there are more than one) first, with inversion of the verb, there is no real need for an order different from that appropriate to indicatives. So let us assume that no special rules about word-order are needed. (48).

One point worth mentioning: how do we know it is a question? Hamblin says: Pragmatically speaking a question sets up a choice-situation between a set of propositions, namely, those propositions that count as answers to it. (48)

i.e. stipulate: When faced with an utterance that is a set of propositions, choose one.
Another point worth mentioning: There is an additional level of complexity we may have to worry about someday. Namely: possible answers may be different in different possible worlds. (Ooo… my brain hurts!) Heim (1994) gave the example What subway line runs to the airport? where in some worlds, there are 4 subway lines, in some there are 5, …

Hamblin’s reply (and maybe what ours should be): Let’s artificially treat certain facts are fixed and only consider possible worlds which do not vary along those dimensions. At least until we are more secure with our semantics.

We would like to think that the phrase ‘what dog’ could be treated as an interrogative proper name denoting the set of dogs, and that ‘what dog walks with Mary’ has as answers just the set ‘x walks with Mary’ where ‘x’ is the name of a dog. But the composition of the set of dogs does not necessarily remain constant from universe to universe: in some universes Rover may be a horse, and Mary herself a dog. I have taken the attitude that when someone answers ‘what dog walks with Mary’ with ‘Rover’ he states not merely that Rover walks with Mary but also implicitly that Rover is a dog, and hence that he states the conjunction. (51).


Point One: Embedded questions are questions too.

(11) I asked John who left.
     I asked John the question “Who left?”

(12) I wonder who left.
     I wonder about the question “Who left?”

(13) *I wonder that John left.

(14) I asked John: {Bill left, Mary left, George left}.

(15) I know {Bill left, Mary left, George left} ——?

(16) I know (the answer to the question) {Bill left, Mary left, George left}.
     Answers are true.

(17) John knows who called.
     Sue called.
     John knows that Sue called. weak exhaustivity

(18) John knows who called.
     Mary did not call.
     John knows that Mary did not call. strong exhaustivity
Who called?

Exhaustivity results follow nicely from this mutually exclusive model.

We might also say that know when it embeds a question is know the complete answer… i.e. Bill called and Mary called.

(19) Where did John go?
(20) John went either to Texas or to California.
(21) John went somewhere.

We can talk of partial answers and complete answers. And sometimes you want a partial answer.

(22) Where can I buy the New York Times?

Focus

(23) John bought a [lamp].

This tells us that John bought a lamp, but it seems to add extra information.

(24) John only bought a [lamp].

(25) John didn’t buy a toaster, John didn’t buy coffee.

(26) Who bought a lamp?
(27) John bought a [lamp].
(28) [John] bought a lamp.

The beginnings of a story about discourse… felicity…

(29) Richard promised [free pizza].
(30) Say, I remember Richard won the election. How is that possible? What did he promise?
(31) Say, I know that it’s Friday and I’m eating free pizza. Someone in the campaign promised this and won… but I can’t remember who. Do you remember? Who promised free pizza?
Note that we’re using pretty much that very same set *Who bought a lamp?* involves.

(32) John also bought a [lamp]$_F$.

**Scales**

(33) John even bought a [lamp]$_F$.

**Grice**

Conversation is generally **cooperative**. Gricean maxims:

A speaker’s contribution is

- relevant (RELATION),
- (only) as informative as required (QUANTITY),
- something for which the speaker has adequate evidence and does not believe to be false (QUALITY),
- unambiguous, succinctly, orderly, and not obscure (MANNER).

(34) How did the test go?

(35) Well, [I]$_F$ passed.


(37) John has two children.

(38) The dinner was adequate.

(39) Mr. Student always showed up to class on time and well-dressed.

(flouting RELATION)