Question composition

Semantics II

March 1 & 5, 2018

The meaning of questions

Up from declaratives

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The meaning of an interrogative sentence is its conditions.

Up from declaratives

The meaning of a declarative sentence is its **truth conditions**.

The meaning of an interrogative sentence is its **answerhood** conditions.

- One way or another, a question tells you what kind of information it seeks.
- Knowing what a question means means knowing how one could answer it.

Basic kinds of questions:

- Polar: *Did you go to the party?*
- Constituent/*wh*: *Who went to the party?*
- Alternative: *Did JOHN or MARY go to the party?*

Questions as properties

Perhaps the most intuitive kind of representation for a question like *who went to the party?* is as a property — a function of type $s \to e \to t$:

$$[\![\text{who went to the party?}]\!]^w = \lambda v \lambda x \in \textbf{human}_w \,.\, \textbf{party}_v \, x$$

The '$\lambda x \in \textbf{human}_w$' indicates that this function, call it 'Q', is defined only for humans in the world of evaluation w — i.e., that:

$$\text{Dom}\,(Q\,v) = \textbf{human}_w$$

A **short answer** like 'Bob' can simply be plugged into the question, to yield truth iff Bob went to the party (provided Bob is a human in w).

$$[\![\text{Qu Ans}]\!]^w = [\![\text{Qu}]\!]^w \, w \, [\![\text{Ans}]\!]^w$$

Questions as sets of alternatives

Another kind of question representation treats questions as denoting **sets of propositions** (Hamblin 1973, Karttunen 1977):

$$[\![\text{who went to the party?}]\!]^w = \underbrace{\{\lambda v.\,\mathbf{party}_v\, x \mid \mathbf{human}_w\, x\}}_{(s\to t)\to t}$$

The partiality condition has turned into a restriction on the kinds of propositions that together comprise the question: each is "about" some human in *w*.

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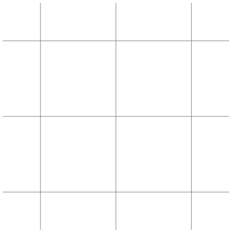
How does this representation provide answerhood conditions? A **long answer** like 'Bob went to the party' should be a member of this set (if Bob is human in *w*).

Questions as partitions

A partition is a special kind of set of propositions, where none of the propositions overlap, and together they cover all of logical space:

$$\textbf{Partition}\, S \iff \forall p, q \in S : p \neq q \Rightarrow p \cap q = \emptyset, \\ \bigcup S = W$$



A partition provides answerhood conditions in the same way as a set of alternatives, but it requires answers to be more specific: a (long) answer to a question must *completely* resolve the issue the question raises.

Derivability relations

Both alternative sets and partitions can be derived from function representations (partitions can also be derived from alternatives, though we won't see that today):

$$\textbf{ToAlt}\, f = \underbrace{\{f_{\mathit{flip}}\, x \mid x \in \mathrm{Dom}\, f_{\mathit{flip}}\}}_{f_{\mathit{flip}} = \lambda x \lambda w.\, f\, w\, x} \qquad \textbf{ToPart}\, g = \lambda w \lambda v.\, g w = g v$$

ToPart treats a partition as an *equivalence relation* on worlds. An equivalence relation groups together worlds that agree completely on who has property f.

Both of these mappings collapse distinctions: functions are finer-grained than alternatives or partitions. This means there are no mappings in the other directions.

Partitions, question in/ex-tensions

An elegant feature of the partition view is that it makes a natural distinction between a question intension and a question extension:

- Intension: $\lambda w \lambda v. (\lambda x. \mathbf{party}_w\, x) = (\lambda x. \mathbf{party}_v\, x)$
- Extension at w: $\lambda v. (\lambda x. \mathbf{party}_w\, x) = (\lambda x. \mathbf{party}_v\, x)$

This corresponds to a difference between verbs that embed question intensions and verbs that embed question extensions:

1. John wonders who came to the party.
2. John knows who came to the party.

The first says that John wonders about a question (i.e., a question intension). The second says that John knows a proposition (i.e., a question extension).

Deriving alternatives

Today

We will focus on constituent questions, which bring up a number of important issues at the interface of syntax and semantics.

We will see a variety of ways their answerhood conditions could be captured, and a variety of ways these answerhood conditions could be compositionally derived.

From sets to characteristic functions

Repeating the alternative-set representation of questions:

$$[\![\text{who went to the party}]\!]^w = \{\lambda v.\, \mathbf{party}_v\, x \mid x \in \mathbf{human}_w\}$$

We know that sets of a's are isomorphic to *characteristic functions*, type $a \to \mathtt{t}$.

What characteristic function describes the set of alternatives given above?

$$\{\lambda v.\, \mathbf{party}_v\, x \mid x \in \mathbf{human}_w\} =$$

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$$\{\lambda v.\, \mathbf{party}_v\, x \mid x \in \mathbf{human}_w\} = \lambda p.\, p \in \{\lambda v.\, \mathbf{party}_v\, x \mid x \in \mathbf{human}_w\}$$
$$=$$

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$$\begin{aligned}\{\lambda v.\, \mathbf{party}_v\, x \mid x \in \mathbf{human}_w\} &= \lambda p.\, p \in \{\lambda v.\, \mathbf{party}_v\, x \mid x \in \mathbf{human}_w\} \\ &= \lambda p.\, \exists x \in \mathbf{human}_w : p = \lambda v.\, \mathbf{party}_v\, x\end{aligned}$$

An *existential quantifier* have been revealed. This is very intriguing.

Question words as existential quantifiers

One reason the appearance of $\exists$ is so intriguing is that there is a cross-linguistically robust connection between indefinites and *wh*-words (Haspelmath 1997).

Languages as varied as Chinese, Japanese, Sinhala, Tlingit, . . .

Even English has words like *some+where*.

Pushing this line

What if we adopted the following very simple hypothesis about *wh*-words?

$$[\![\text{who}]\!]^w = \underbrace{\lambda f.\,\exists x \in \textbf{human}_w : f\,x}_{(e\to t)\to t} \qquad [\![\text{which}]\!]^w = \underbrace{\lambda f.\,\lambda g.\,\exists x \in f : g\,x}_{(e\to t)\to(e\to t)\to t}$$

This is a start, but it doesn't yet allow us to generate *sets* of propositions as semantic values for questions. To do that we'll need some extra pieces.

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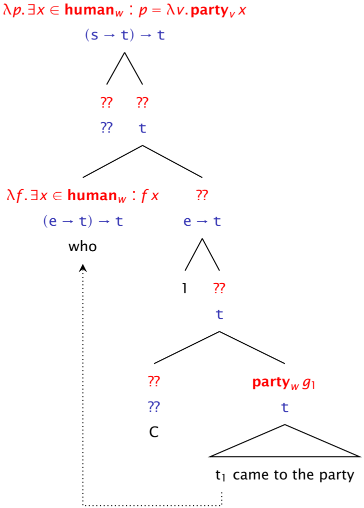
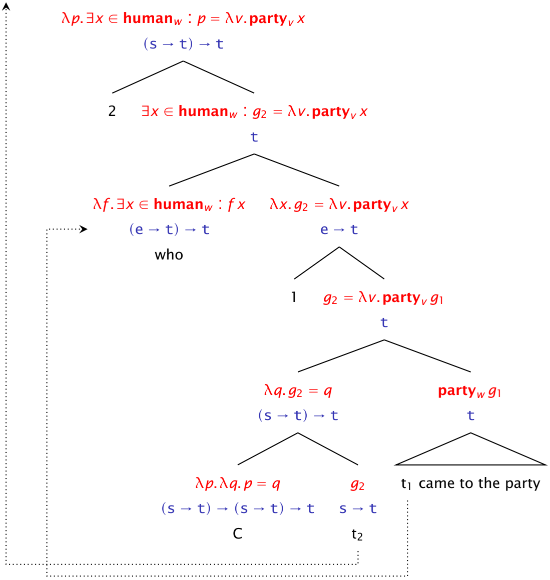
Fortunately, questions aren't simply declarative sentences. What do they have that declaratives are missing? **An interrogative C!** Moreover, we know that in simple *wh*-questions (i.e., with just one *wh*-word), the *wh*-word moves *above C*.

Getting started



Filling in the missing pieces (Heim 2011, Fox 2012)



Higher-typed *wh* words (Karttunen 1977, Cresti 1995)

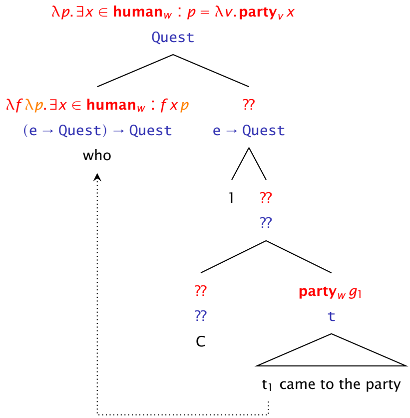
Another possibility treats *wh* words as *quantifying into questions*. Using $\mathtt{Quest}$ to abbreviate the type of questions (i.e., $\mathtt{Quest} ::= (\mathtt{s} \to \mathtt{t}) \to \mathtt{t}$), we have:

$$[\![\text{who}]\!]^w = \underbrace{\lambda f \lambda p. \exists x \in \textbf{human}_w : f\,x\,p}_{(\mathtt{e}\to\mathtt{Quest})\to\mathtt{Quest}} \qquad [\![\text{which}]\!]^w = \underbrace{\lambda f \lambda g \lambda p. \exists x \in f : g\,x\,p}_{(\mathtt{e}\to\mathtt{t})\to(\mathtt{e}\to\mathtt{Quest})\to\mathtt{Quest}}$$

One reason this might be more attractive than treating *wh* words as having type $(\mathtt{e} \to \mathtt{t}) \to \mathtt{t}$: *wh* words don't ever take scope below C, at least in English.

- The proposal here predicts this, as a matter of *wh* semantics (if C introduces the $\mathtt{Quest}$ type, *wh* must scope above C).

Getting started



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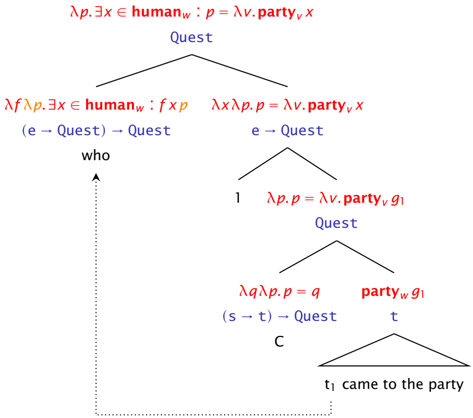

Make u think

Can you define a mapping from a generalized quantifier to something that quantifies into questions — i.e., with the following type?

$$((\mathtt{e} \to \mathtt{t}) \to \mathtt{t}) \to (\mathtt{e} \to \mathtt{Quest}) \to \mathtt{Quest}$$

Would there be any empirical concerns about such a mapping?

Suppose we treated *wh* words as properties or sets of individuals — i.e., having base type $\mathtt{e} \to \mathtt{t}$ (Hamblin 1973). Can you define a mapping from this to a *wh*-quantifier?

$$(\mathtt{e} \to \mathtt{t}) \to (\mathtt{e} \to \mathtt{Quest}) \to \mathtt{Quest}$$

Are there fewer empirical concerns about such a mapping than the first one?

Finally, the categorial approach

Last of all, in the categorial approach, it is natural to treat *wh* words as contributing very little to composition beyond a presuppositional restriction:

$$[\![\text{who}]\!]^w = \underbrace{\lambda f \lambda x \in \textbf{human}_w . f\,x}_{(\mathrm{e}\to a)\to \mathrm{e}\to a} \qquad [\![\text{which}]\!]^w = \underbrace{\lambda f \lambda g \lambda x \in f . g\,x}_{(\mathrm{e}\to \mathrm{t})\to(\mathrm{e}\to a)\to \mathrm{e}\to a}$$

Notice that these functions are *polymorphic*: they do not care what type f returns, so long as f takes an entity as its input. Why is this important?

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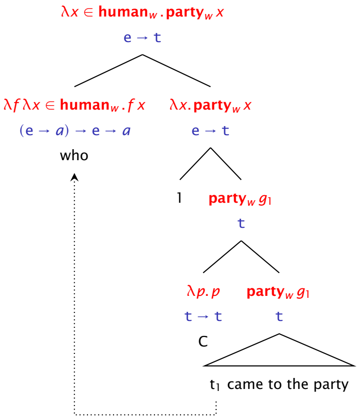
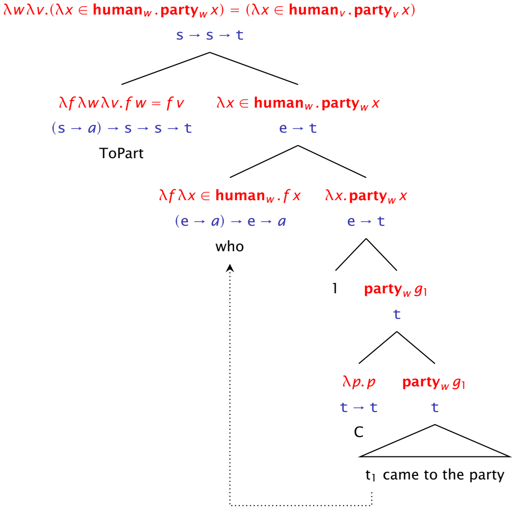
Notice that these functions are *polymorphic*: they do not care what type f returns, so long as f takes an entity as its input. Why is this important? Multiple-*wh*!

Categorial derivations are particularly simple



Mapping to partitions via ToPart, IFA



Thinking about what we've got

The two sets-of-propositions approaches are quite similar. The first seems to imply some kind of null operator movement. What kind of thing could be moving? Could it be associated with some kind of semantics?

Do multiple-*wh* constructions work? Do *all* of them work?

3. Who read what?
4. Who knows who read what?
5. Which linguist will be mad if we invite which philosopher?

Virtues of different approaches

Categorial semantics:

- Offers a particularly direct account of question answers.
- Can be naturally used to generate partition semantics.

Partition semantics:

- Question entailment works naturally. Any complete and total answer to *who came?* will entail a complete and total answer to *did John come?*
- Disjunctions don't fall out immediately (disjunctions of partitions are not in general partitions). But (a) the data is pretty suspect, and (b) it is easy to extend the partition theory, as Groenendijk & Stokhof (1989) show.

Disjoining questions

Generalized disjunction and entailment (Partee & Rooth 1983):

$$X \sqcup Y = \begin{cases} X \vee Y & \text{if } X, Y : \mathsf{t} \\ \lambda c.\, X\, c \sqcup Y\, c & \text{otherwise} \end{cases} \qquad X \sqsubset Y = \begin{cases} X \Rightarrow Y & \text{if } X, Y : \mathsf{t} \\ \lambda c.\, X\, c \sqsubset Y\, c & \text{otherwise} \end{cases}$$

A LIFT operation for turning x into the boss:

$$\textbf{LIFT}\, x = \lambda c.\, c\, x$$

Combining these to disjoin two question meanings:

$$\lambda f.\, f\, \mathcal{Q}_1 \vee f\, \mathcal{Q}_2$$

It is clear that both $\textbf{LIFT}\, \mathcal{Q}_1$ and $\textbf{LIFT}\, \mathcal{Q}_2$ entail this.

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