Multiple questions and pair-list readings

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1 Uniqueness presupposition

Singular *which*-questions to carry a uniqueness presupposition.

(1) a. Which guest arrived?
b. Kramer arrived.
c. #Kramer and Jerry arrived.

(2) a. Which guests arrived?
b. Kramer arrived.
c. Kramer and Jerry arrived.

Simplex *wh*-phrases, on the other hand, do not.

(3) a. Who arrived?
b. Kramer arrived.
c. Kramer and Jerry arrived.

1.1 Plurality primer

I assume an ontology where singular NPs range over atomic individuals, and plural NPs range over sets of individuals (Schwarzchild etc.).

(4) $[\![\text{guest}]\!] = \lambda x_e . x \in G_w = \{\text{Kramer, Jerry, Elaine}\}$

(5) $[\![\text{guests}]\!] = \lambda X_{et} . X \neq \emptyset \wedge X \subseteq G_w$
$= \{\{\text{Kramer}\}, \{\text{Jerry}\}, \{\text{Elaine}\},$
$\{\text{Kramer, Jerry}\}, \{\text{Kramer, Elaine}\}, \{\text{Jerry, Elaine}\}\}$
$\{\text{Kramer, Jerry, Elain}\}\}$

(6) $[\![\text{-s}]\!] = \lambda P'_{et} . \lambda P_{et} . P \neq \emptyset \wedge P \subseteq P'$

The plural definite article the_{pl} presupposes that there a maximal subset of the denotation of the plural NP, and picks it out.

(7) a. $Q_{et,t}$ is dom(the_{pl}) only if $\exists X_{et}[X \in Q \wedge \forall X'[X' \in Q \rightarrow X \subseteq X']]$
b. Whenever defined,
$\text{the}_{\text{pl}}(Q) = \iota X[X \in Q \wedge \forall X'[X' \in Q \rightarrow X \subseteq X']]$

(8) $[\![\text{the}_{\text{pl}} \text{ guests}]\!]^w = \{\text{Kramer, Jerry, Elaine}\}$

Distributive predicates are of type $\langle e, t\rangle$, whereas collective predicates are of type $\langle\langle e, t\rangle, t\rangle$.

(9) a. $[\![\text{smoke}]\!]^w = \lambda x_e . x \in S_w$
b. $[\![\text{gather}]\!]^w = \lambda X_{et} . X \in G_w$

Singular DPs are of type e, and therefore can compose with distributive predicates, but not collective predicates. Plural DPs are of type $\langle e, t\rangle$, and therefore can compose with collective predicates but not distributive predicates.

A distributive operator D (which has the same denotation as the plural morpheme *-s*) is standardly used to shift distributive predicates to a higher type, allowing them to compose with a plural DP.

(10) $[\![D]\!] = [\![\text{-s}]\!] = \lambda P'_{et} . \lambda P_{et} . P \neq \emptyset \wedge P \subseteq P'$

(11) $D([\![\text{smoke}]\!]^w) = \lambda P_{et}.P \neq \emptyset \wedge P \subseteq S_w$

(12) $[\![\text{The guests smoke}]\!]^w = 1$ iff $\{\text{Kramer, Jerry, Elaine}\} \subseteq D(S_w)$

1.2 Dayal on uniqueness presuppositions

Core idea: questions presuppose the existence of a maximally informative true answer.

Dayal assumes that questions denote sets of possible answers.

(13) $[\![\text{Which guest arrived}]\!]^w = \{p_{st} \mid \exists x_e[x \in G_w \wedge p = \lambda w'.x \in A_{w'}]\}$

We can define an answerhood operator as follows:

(14) a. $Q_{st,t} \in \text{dom}(\text{ANS}_{\text{Dayal}_w})$ iff $\exists p_{st}[p \in Q \wedge p(w) \wedge \forall p'[(p' \in Q \wedge p'(w)) \rightarrow p \subseteq p']]$
b. Whenever defined, $\text{ANS}_{w0}(Q) = \iota p[p \in Q \wedge \forall p'[(p' \in Q \wedge p'(w)) \rightarrow p \subseteq p']]$

N.b. that $\text{ANS}_{\text{Dayal}}$ is the counterpart of the_{pl} in the domain of propositions..

Now we have an answer for why singular *which*-questions carry a uniqueness presupposition – this comes from the combination of the singular NP restrictor, and the presupposition that there is a unique maximally informative answer contributed by $\text{ANS}_{\text{Dayal}}$.

- Kramer arrived, Jerry arrived, and Elaine didn't arrive in w.

(15) $[\![\text{Which guest arrived}]\!]^w = \left\{ \begin{array}{l} \lambda w'.\ \text{Kramer} \in A_{w'} \\ \lambda w'.\ \text{Jerry} \in A_{w'} \\ \lambda w'.\ \text{Elaine} \in A_{w'} \end{array} \right\}$

(16) $\text{ANS}_{\text{Dayal}}([\![(15)]\!]) = \text{undefined}$

- Only Kramer arrived in w.

(17) $\text{ANS}_{\text{Dayal}}([\![(15)]\!]) = \lambda w'.\text{Kramer} \in A_{w'}$

We correctly predict that questions with plural *which*-phrases don't carry a uniqueness presupposition:

- Kramer arrived, Jerry arrived, and Elaine didn't arrive in w.

(18) $[\![\text{Which guests arrived}]\!]^w = \left\{ \begin{array}{l} \lambda w'.\ \{\text{Kramer}\} \in D(A_{w'}) \\ \lambda w'.\ \{\text{Jerry}\} \in D(A_{w'}) \\ \lambda w'.\ \{\text{Elaine}\} \in D(A_{w'}) \\ \lambda w'.\ \{\text{Kramer, Jerry}\} \in D(A_{w'}) \\ \lambda w'.\ \{\text{Kramer, Elaine}\} \in D(A_{w'}) \\ \lambda w'.\ \{\text{Jerry, Elaine}\} \in D(A_{w'}) \\ \lambda w'.\ \{\text{Kramer, Jerry, Elaine}\} \in D(A_{w'}) \end{array} \right\}$

(19) $\text{ANS}_{\text{Dayal}}([\![(18)]\!]) = \lambda w'.\{\{\text{Kramer, Jerry}\}\} \in D(A_{w'})$

Note furthermore that $\text{ANS}_{\text{Dayal}}$ also derives an *existential* presupposition for questions. Consider the following context:

No guests arrived in w.

(20) $[\![\text{Which guest arrived?}]\!]^w = \emptyset$
$\text{ANS}_{\text{Dayal}}(\emptyset)$ is undefined

1.3 More applications of $\text{ANS}_{\text{Dayal}}$

$\text{ANS}_{\text{Dayal}}$ can also be used to account for maximality/minimality effects in *degree questions*.

(21) *Context: the answerer knows that George read three books.*

a. How many books did George read?
b. #George read two books.
c. George read three books.

(22) *Context: the answerer knows that three eggs are sufficient to make an omelette*

a. How many eggs are sufficient to make an omelette?
b. Three eggs are sufficient to make an omelette.
c. #Four eggs are sufficient to make an omelette.

(23)

$$
\begin{aligned}
&[\![\text{How many books did George read?}]\!]^w \\
&= \{p_{st} \mid \exists d[d \in \mathbb{N} \wedge \\
&p = \lambda w'.\text{George read}_{w'}\ d\text{-many books}] \\
&= \left\{ \begin{array}{l} ... \\ \lambda w'.\ \text{George read}_{w'}\ \text{one book}\ ① \\ \lambda w'.\ \text{George read}_{w'}\ \text{two books}\ ② \\ \lambda w'.\ \text{George read}_{w'}\ \text{three books}\ ③ \\ \lambda w'.\ \text{George read}_{w'}\ \text{four books}\ ④ \\ ... \end{array} \right\}
\end{aligned}
$$

④ $\subseteq$ ③ $\subseteq$ ② $\subseteq$ ①, and ④ is false, therefore $\text{ANS}_{\text{Dayal}}$ is defined, and returns the proposition *that George read three books* as the maximally informative true answer.

(24)

$$
\begin{aligned}
&[\![\text{How many eggs are sufficient to make an omelette?}]\!]^w \\
&= \{p_{st} \mid \exists d[d \in \mathbb{N} \wedge \\
&p = \lambda w'.d\text{-many eggs are sufficient to make an omelette}_{w'}] \\
&= \left\{ \begin{array}{l} ... \\ \lambda w'.\ \text{one egg is sufficient...}_{w'}\ ① \\ \lambda w'.\ \text{two eggs are sufficient...}_{w'}\ ② \\ \lambda w'.\ \text{three eggs are sufficient...}_{w'}\ ③ \\ \lambda w'.\ \text{four eggs are sufficient...}_{w'}\ ④ \\ ... \end{array} \right\}
\end{aligned}
$$

This time the direction of entailment is reversed: ① $\subseteq$ ② $\subseteq$ ③ $\subseteq$ ④. ① and ② are false, therefore $\text{ANS}_{\text{Dayal}}$ is defined, and it returns the proposition *that three eggs are sufficient to make an omelette* as the maximally informative true answer.

Furthermore, $\text{ANS}_{\text{Dayal}}$ derives the sensitivity of degree questions to negation, as a matter of the semantics of questions.

(25) #How many books didn't George read?

In an out-of-the-blue context, there is no upper bound to the number of books d, s.t. George *didn't* read d-many books, therefore $\text{ANS}_{\text{Dayal}}$ is not defined for (25), since for any given answer of the form *George didn't read d-many books*, there exists a more informative answer *George didn't read d'-many books*, s.t., $d' > d$.

If we explicitly supply an upper-bound, the question (as predicted) becomes better:

(26) Out of these ten books, how many didn't George read?

1.4 Uniqueness as a lexical presupposition

...

1.5 Uniqueness shift with multiple questions

Singular *which*-phrases no longer carry uniqueness presuppositions in multiple questions.

(27) a. Which woman is dating which man?
b. Elaine is dating Jerry.
c. Elaine is dating Jerry, and Susan is dating George.

First attempt at a denotation for a multiple question: set of (true) answers.

(28) $[\![\text{Which woman is dating which man?}]\!]^w$
$= \{p_{st} | p(w) \wedge \exists x, y[x \in W_w \wedge y \in M_w \wedge p = \lambda w'.\langle x, y\rangle \in D_{w'}]\}$

(29) $[\![\text{Which guest arrived}]\!]^w$
$$= \left\{ \begin{array}{l} \lambda w'.\ \langle \text{Elaine, Jerry}\rangle \in D_{w'} \\ \lambda w'.\ \langle \text{Susan, George}\rangle \in D_{w'} \end{array} \right\}$$

(30) $\text{ANS}_{\text{Dayal}}([\![(28)]\!]) = \text{undefined}$

- Applying Dayal's answerhood operator to the simple meaning in (28) gets **the wrong result**.

2 Multiple questions

2.1 Exhaustivity and pointwise uniqueness

(31) **Exhaustivity**
"...a question with a wh in subject and a wh in object position presupposes that a list answer will exhaustively pair every member of the subject term, but not necessarily every member of the object term."
(Dayal 1996, p. 105).

(32) a. Speaker A: We're organizing singles tennis games between men and women. There are three men interested in playing against women, namely Bill, Mike and John. But there are four women interested in playing against men, namely Mary, Sue, Jane and Sarah.
b. Speaker B: So, which man is playing against which woman?

(33) a. Speaker A: We're organizing singles tennis games between men and women. There are four men interested in playing against women, namely Harry, Bill, Mike and Jonn. But there are only three women interested in playing against men, namely Mary, Sue and Jane.
b. Speaker B: #So, which man is playing against which woman?

(34) **Pointwise uniqueness (functionhood):**
"We can say that an appropriate answer to a multiple wh question pairs each member of the subject term with a member of the object term. This pairing can be one-one or many-one, but crucially not one-many. The contrast that shows this is quite sharp and calls for an explanation. "
(Dayal 1996, p. 108)

(35) a. Which student read which book?
b. John read Moby Dick, and Bill read Moby Dick too.
John and Bill both read Moby Dick.
c. #John read Moby Dick and War and Peace.

Engdahl's example:

(36) a. Which table ordered which wine?

b. Table A ordered the Ridge Zinfandel, Table Bordered the Chardonay and Table C ordered the Rose and the Bordeaux.

> "I argued that acceptable violations of bijectivity, such as [(35)], typically involve situations in which most of the pairings respect bijectivity and are therefore amenable to a pragamatic explanation. The questioner in [(35-a)], for example, probably expects each table to have ordered a single wine. Knowing that questions are usually exhaustive requests for information, a cooperative interlocuter may provide an answer which includes pairings which violate bijectivity, implicitly denying the questioner's presupposition."
>
> (Dayal 1996, p. 108)

2.2 MQs as questions about functions

Dayal's (1996) idea is that the restrictor of the higher *wh*-phrase supplies the *domain* of the function, and the restrictor of the lower *wh*-phrase supplies the *range* of the function.

(37) $[\![\text{Which woman is dating which man?}]\!]^w$
$= \{p_{st} \mid \exists f_{\langle e,e\rangle}[\text{Dom}(f) = W_w \wedge \text{Range}(f) = M_w \wedge p = \bigcap\{p' \mid p'(w) \wedge \exists x[p' = \lambda w'.\langle x, f(x)\rangle \in D_{w'}]\}]\}$

$$= \left\{ \begin{array}{l} \bigcap\left\{ \begin{array}{l} \lambda w'.\langle \text{Elaine}, f_1(\text{Elaine})\rangle \in D_{w'} \\ \lambda w'.\langle \text{Susan}, f_1(\text{Susan})\rangle \in D_{w'} \end{array} \right\} \\ \bigcap\left\{ \lambda w'.\langle \text{Elaine}, f_2(\text{Elaine})\rangle \in D_{w'} \right\} \end{array} \right\}$$

$$= \left\{ \begin{array}{l} \lambda w'.\langle \text{Elaine}, \text{Jerry}\rangle \in D_{w'} \wedge \langle \text{Susan}, \text{George}\rangle \in D_{w'} \\ \lambda w'.\langle \text{Elaine}, \text{Jerry}\rangle \in D_{w'} \end{array} \right\}$$

- $f_1(\text{Elaine}) = \text{Jerry}$
- $f_1(\text{Susan}) = \text{George}$
- $f_2(\text{Elaine}) = \text{Jerry}$
- $f_2(\text{Susan}) = \text{Jerry}$
- ...

$\text{ANS}_{\text{Dayal}}$ applied to the set containing the propositions *that Elaine dates Jerry and Susan dates George* and *that Elaine dates Jerry*, returns the unique, maximally informative proposition: *that Elaine dates Jerry and Susan dates George*. If *pointwise uniqueness* fails to hold, $\text{ANS}_{\text{Dayal}}$ is undefined. To see why, consider the following context:

Elaine is dating Jerry in w; Susan is dating Jerry and George in w.

(38) $[\![\text{Which woman is dating which man?}]\!]^w$

$$= \left\{ \begin{array}{l} \bigcap\left\{ \begin{array}{l} \lambda w'.\langle \text{Elaine}, f_1(\text{Elaine})\rangle \in D_{w'} \\ \lambda w'.\langle \text{Susan}, f_1(\text{Susan})\rangle \in D_{w'} \end{array} \right\} \\ \bigcap\left\{ \begin{array}{l} \lambda w'.\langle \text{Elaine}, f_2(\text{Elaine})\rangle \in D_{w'} \\ \lambda w'.\langle \text{Susan}, f_2(\text{Susan})\rangle \in D_{w'} \end{array} \right\} \end{array} \right\}$$

$$= \left\{ \begin{array}{l} \lambda w'.\langle \text{Elaine}, \text{Jerry}\rangle \in D_{w'} \wedge \langle \text{Susan}, \text{George}\rangle \in D_{w'} \\ \lambda w'.\langle \text{Elaine}, \text{Jerry}\rangle \in D_{w'} \wedge \langle \text{Susan}, \text{Jerry}\rangle \in D_{w'} \end{array} \right\}$$

$\text{ANS}_{\text{Dayal}}$ applies to the set above is crucially undefined, since there is no *unique* maximally informative proposition in the set.

2.3 MQs as sets of questions

An alternative solution is to posit *higher-order question meaning* for multiple questions (Fox 2012, Kotek 2014) .

(39) $[\![\text{Which woman is dating which man}]\!]^w$
$= \{Q_{st,t} \mid \exists x[x \in W_w \wedge$
$Q = \{p_{st} \mid p(w) \wedge \exists y[y \in M_w \wedge$
$p = \lambda w'.\langle x, y\rangle \in D_{w'}]\}]\}$

$$= \left\{ \begin{array}{l} [\![\text{Which man is Elaine dating?}]\!]^w \\ [\![\text{Which man is Susan dating?}]\!]^w \end{array} \right\}$$

$$= \left\{ \begin{array}{l} \{ \lambda w'.\langle \text{Elaine, Jerry}\rangle \in D_{w'} \} \\ \{ \lambda w'.\langle \text{Susan, George}\rangle \in D_{w'} \} \end{array} \right\}$$

On the face of it, this doesn't seem to help, since $\text{ANS}_{\text{Dayal}}$ will still be undefined for the set in (39).

However, positing the more complex meaning for the multiple question allows us to define a new answerhood operator ANS_{MQ}.

Intuitively, ANS_{MQ} gives back the *intersection* of the result of $\text{ANS}_{\text{Dayal}}$ applied to each question belonging to the set denoted by the multiple question.

THIS ISN'T QUITE RIGHT YET.

(40) $\text{ANS}_{\text{MQ}}([\![(38)]\!])$
$= \lambda w'.\langle \text{Elaine, Jerry}\rangle \in D_{w'} \wedge \langle \text{Susan, George}\rangle \in D_{w'}$

(41) $\text{ANS}_{\text{MQ}}(Q) = \bigcap_{q \in Q} \text{ANS}_{\text{Dayal}}(q)$

(42) $\text{ANS}_{\text{MQ}}([\![\text{pl2}]\!])$
$= (\lambda w'.\langle \text{Elaine, Jerry}\rangle \in D_{w'}) \cap (\lambda w'.\langle \text{Susan, George}\rangle \in D_{w'})$
$= \lambda w'.\langle \text{Elaine, Jerry}\rangle \in D_{w'} \wedge \langle \text{Susan, George}\rangle \in D_{w'}$

ANS_{MQ} in tandem with the shift in perspective from sets of answers to *sets of questions* gets us the right result.

(43) $[\![\text{ANS}]\!]^w = \lambda Q.\exists p$

(44) $\text{ANS(Q)} = \lambda w.[\![\text{ANS}]\!]^w(Q)$

References

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