Relational arguments in (meta-)questions
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1. Underlying (but deceptive) idea: relational noun phrases as donkeys

John knows the price of milk. **R**elational
John knows the price.
John knows the price of y **C**ontextual
John knows the price of something. **S**et

John knows every price.
(every x) (x is the price of y) (John knows x is the price of y) **C**
(every x) (x is the price of something) (John knows x is the price of something) **S**
(every x) (x is the price of some thing y) (John knows x is the price of y) **P**air-List
(every f) (f is the price of something) (John knows f) **F**unctional

John knows every price Mary knows.

(every x) (x is the price of some thing y and Mary knows that x is the price of some thing y) (John knows that x is the price of y) **AP**
(every f) (f is the price of something and Mary knows f) (John knows f)

(every x) (Mary knows that x is the price of something) (John knows that x is the price of something) **AS**

(every f) (f is the price of something and Mary knows f) (John knows that Mary knows f) **BP**

(every x) (Mary knows that x is the price of something) (John knows that Mary knows that x is the price of something) **BS**

2. Relevant type shifts

• *Donkey type/domain shifts [extensional versions]*

$Q(R,S) \Leftrightarrow (Qxy)\ (R(x,y);\ S(x,y))$ symmetric

$Q(R,S) \Leftrightarrow (Qx)\ ((\exists y)\ R(x,y);\ (\exists y)\ [R(x,y)\ \&\ S(x,y)])$ existential

$Q(R,S) \Leftrightarrow (Qx)\ ((\exists y)\ R(x,y);\ (\forall y)\ [R(x,y) \rightarrow S(x,y)])$ universal

• *Shifting relational nouns*

$price^{2}$: $\lambda w_0.\ \lambda y.\ \lambda x.\ \pi_{w_0}(y) = x$

$price^{c}$: $\lambda w_0.\ \lambda x.\ \pi_{w_0}(y_0) = x$

$price^{\exists}$: $\lambda w_0.\ \lambda x.\ (\exists y)\ \pi_{w_0}(y) = x$

$price^{\uparrow}$: $\lambda y.\ \lambda P.\ P = \lambda w_0.\ \lambda x.\ \pi_{w_0}(y) = x$

$price^{\uparrow\exists}$: $\lambda P.\ (\exists y)\ P = \lambda w_0.\ \lambda x.\ \pi_{w_0}(y) = x$

3. Eamples

• *Basic*

every: $\forall$

$every^{sym}\ price^{2}$: $\lambda w_0.\ \lambda S.\ (\forall xy)\ [\pi_{w_0}(y) = x \rightarrow S(w_0)(y)(x)]$

$know^{2}$: $\lambda w_0.\ \lambda R.\ \lambda z.\ \lambda y.\ \lambda x.\ (\forall w \in Epi^{z}_{w_0})\ [R(w)(y)(z) \leftrightarrow R(w_0)(y)(z)]$

John knows^2 [*price*^{2}]: $\lambda w_0. \lambda y. \lambda x. (\forall w \in Epi^j_{w_0}) [\pi_{w_0}(y) = x \leftrightarrow \pi_w(y) = x]$

(*every*^{sym} *price*^{2}) *John knows*^{2} [*price*^{2}]: **P**

$$\lambda w_0. (\forall xy) [\pi_{w_0}(y) = x \rightarrow (\forall w \in Epi^j_{w_0}) [\pi_{w_0}(y) = x \leftrightarrow \pi_w(y) = x]]$$

$$\equiv \lambda w_0. (\forall y) (\forall w \in Epi^j_{w_0}) [\pi_w(y) = \pi_{w_0}(y)]$$

$$\equiv \lambda w_0. (\forall y) (\exists x) (\forall w \in Epi^j_{w_0}) \pi_w(y) = x$$

(*most*^{sym} *prices*^{2}) *John knows*^{2} [*price*^{2}]: **P**

$$\lambda w_0. (\text{MOST } xy) [\pi_{w_0}(y) = x; (\forall w \in Epi^j_{w_0}) [\pi_{w_0}(y) = x \leftrightarrow \pi_w(y) = x]]$$

$$\equiv \lambda w_0. (\text{MOST } y) (\forall w \in Epi^j_{w_0}) [\pi_w(y) = \pi_{w_0}(y)]$$

(*most*^{sym} *addresses*^{2}) *John knows*^{2} [*address*^{2}]:

$$\lambda w_0. (\text{MOST } xy) [A_{w_0}(y)(x); (\forall w \in Epi^j_{w_0}) [A_{w_0}(y)(x) \leftrightarrow A_w(y)(x)]]$$

$$\equiv \lambda w_0. (\text{MOST } xy) [A_{w_0}(y)(x); (\forall w \in Epi^j_{w_0}) A_w(y)(x)]$$

(*most*$^{\exists}$ *prices*^{2}) *John knows*^{2} [*price*^{2}]:

$$\equiv \lambda w_0. (\text{MOST } x) ((\exists y)\ x = \pi_w(y); (\exists y) [x = \pi_w(y) \ \& \ (\forall w \in Epi^j_{w_0}) [\pi_w(y) = x]])$$

'For most prices x, John knows something that x is a price of' **U**nattested ?

(*most*$^{\forall}$ *prices*^{2}) *John knows*^{2} [*price*^{2}]:

$$\equiv \lambda w_0. (\text{MOST } x) ((\exists y)\ x = \pi_w(y); (\forall y) [x = \pi_w(y) \rightarrow (\forall w \in Epi^j_{w_0}) \pi_w(y) = x])$$

'For most prices x, John knows everything that x is a price of' **U**?

(*most*$^{\exists}$ *addresses*^{2}) *John knows*^{2} [*address*^{2}]:

$$\lambda w_0. (\text{MOST } x) ((\exists y)\ A_{w_0}(y)(x); (\exists y) [A_{w_0}(y)(x) \ \& \ (\forall w \in Epi^j_{w_0}) [A_w(y)(x) \leftrightarrow A_{w_0}(y)(x)]])$$

'For most addresses, John knows someone with that address' **?**

(*most*$^{\forall}$ *addresses*^{2}) *John knows*^{2} [*address*^{2}]:

$$\lambda w_0. (\text{MOST } x) ((\exists y)\ A_{w_0}(y)(x); (\forall y) [A_{w_0}(y)(x) \rightarrow (\forall w \in Epi^j_{w_0}) [A_w(y)(x) \leftrightarrow A_{w_0}(y)(x)]])$$

'For most addresses, John knows everyone with that address' **?**

(*most addresses*$^{\exists}$) *John knows*^{1} [*address*$^{\exists}$]: **S**

$$\lambda w_0. (\text{MOST } x) ((\exists y)\ A_{w_0}(y)(x); (\forall w \in Epi^j_{w_0}) (\exists y)\ A_{w_0}(y)(x))$$

(*most addresses*^{c}) *John knows*^{1} [*address*$^{\exists}$]: ✓

$$\lambda w_0. (\text{MOST } x) (A_{w_0}(y_0)(x); (\forall w \in Epi^j_{w_0}) A_{w_0}(y_0)(x))$$

(*exactly two*^{sym} *addresses*^{2}) *John knows*^{2} [*address*^{2}]: ✓ (?)

$$\equiv \lambda w_0. (\exists_{=2} xy) [A_{w_0}(y)(x) \ \& \ (\forall w \in Epi^j_{w_0}) A_w(y)(x)]$$

(exactly two$^{\exists}$ *addresses*^{2}*) John knows*^{2} *[address*^{2}*]:* **U**

$$\equiv \lambda w_0.\ (\exists_{=2}x)\ (\exists y)\ [A_{w_0}(y)(x)\ \&\ (\forall w \in Epi^{j}_{w_0})\ A_w(y)(x)]$$

'John knows exactly two addresses of the only person of whom he knows more than one address'

(exactly two$^{\forall}$ *addresses*^{2}*) John knows*^{2} *[address*^{2}*]:* **U**

$$\equiv \lambda w_0.\ (\exists_{=2}x)\ (\forall y)\ [A_{w_0}(y)(x) \rightarrow (\forall w \in Epi^{j}_{w_0})\ A_w(y)(x)]$$

'There are exactly two addresses all of whose holders John knows to hold these addresses'

• MISSING READINGS (?) of *John knows exactly two addresses*

$\lambda w_0.\ (\exists_{=2}y)\ (\exists x)\ [A_{w_0}(y)(x)\ \&\ (\forall w \in Epi^{j}_{w_0})\ A_w(y)(x)]$

$\lambda w_0.\ (\exists_{=2}y)\ (\forall x)\ [A_{w_0}(y)(x) \rightarrow (\forall w \in Epi^{j}_{w_0})\ A_w(y)(x)]$

• *Heim's Ambiguity: A-readings*

Mary knows^{2} *[price*^{2}*]:* $\lambda w_0.\ \lambda y.\ \lambda x.\ (\forall w \in Epi^{j}_{w_0})\ [\pi_{w_0}(y) = x \leftrightarrow \pi_w(y) = x]$

price that Mary knows^{2} *[price*^{2}*]:* $\lambda w_0.\ \lambda y.\ \lambda x.\ (\forall w \in Epi^{j}_{w_0})\ [\pi_{w_0}(y) = x \leftrightarrow \pi_w(y) = x]$

every^{sym} *price*^{2} *that Mary knows*^{2} *[price*^{2}*]:*

$$\lambda w_0.\ \lambda S.\ (\forall xy)\ [\ (\forall w \in Epi^{m}_{w_0})\ [\pi_{w_0}(y) = x \leftrightarrow \pi_w(y) = x] \rightarrow S(w_0)(y)(x)]$$

(every^{sym} *price*^{2} *that Mary knows*^{2} *[price*^{2}*]) John knows*^{2} *[price*^{2}*]:* **AP**

$$\lambda w_0.\ (\forall xy)\ [\ (\forall w \in Epi^{m}_{w_0})\ [\pi_{w_0}(y) = x \leftrightarrow \pi_w(y) = x] \rightarrow (\forall w \in Epi^{j}_{w_0})\ [\pi_{w_0}(y) = x \leftrightarrow \pi_w(y) = x])$$

(most^{sym} *addresses that Mary knows*^{2} *[address*^{2}*]) John knows*^{2} *[address*^{2}*]:*

$$\lambda w_0.\ (\forall xy)\ [\ (\forall w \in Epi^{m}_{w_0})\ [A_{w_0}(y)(x) \leftrightarrow A_w(y)(x)];\ (\forall w \in Epi^{j}_{w_0})\ [A_w(y)(x) \leftrightarrow A_{w_0}(y)(x)])$$

etc.

(most^{sym} *addresses that Mary knows*^{1} *[address*$^{\exists}$*]) John knows*^{1} *[address*$^{\exists}$*]:* **AS**

$$\lambda w_0.\ (\text{MOST}\ x)\ [\ (\forall w \in Epi^{m}_{w_0})\ [(\exists y)\ A_{w_0}(y)(x) \leftrightarrow (\exists y)\ A_w(y)(x)];$$
$$(\forall w \in Epi^{j}_{w_0})\ [(\exists y)\ A_w(y)(x) \leftrightarrow (\exists y)\ A_{w_0}(y)(x)])$$

Reference

Percus, Orin: 'The concoealed questions view of concealed questions'. Talk given here yesterday.