The problem of presupposition projection in question-embedding

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Background

The overarching goal

A goal of the semantics of question-embedding

To provide a unified analysis of the interpretations of :

- x *Vs Q* (e.g., *Max knows who danced.*)
- x *Vs* that *p* (e.g., *Max knows that Pat danced.*)

across different predicates *V*.

- Recent progress (e.g., Spector&Egre 2015; Xiang 2016; Theiler et al. 2018) following pioneering works (e.g., Karttunen 1977; Groenendijk&Stokhof 1984; Heim 1994).
- This talk: focus on the *presuppositions* of these constructions, especially the uniqueness presupposition of singular-*which* questions.

Uniqueness presupposition of singular-*which* questions

A question involving a singular *which*-phrase of the form $\textit{Which NP } \varphi\textit{?}$ presupposes that ***exactly one NP*** φ.

(1) ***Which student*** in the class smokes?

$\overset{\text{presup}}{\Rightarrow}$ ***Exactly one student*** in the class smokes.

(2) ***Which book*** did Max read in the weekend?

$\overset{\text{presup}}{\Rightarrow}$ Max read ***exactly one book*** in the weekend.

Comorovski (1989); Dayal (1996); cf. Groenendijk&Stokhof (1984)

Projection of the uniqueness presupposition

Goal

To account for the projection pattern of the uniqueness presupposition of singular-*which* question in sentences of the form $\ulcorner x\ Vs\ Q \urcorner$.

(3) a. Max **knows** which student smokes.
$\overset{\text{presup}}{\Rightarrow}$ Exactly one student smokes.

b. Max **is certain** (about) which student smokes.
$\overset{\text{presup}}{\Rightarrow}$ Max believes that exactly one student smokes.

c. Max **agrees** with Kim on which student smokes.
$\overset{\text{presup}}{\Rightarrow}$ Max and Kim believe that exactly one student smokes.

Additional desideratum

The account has to be compatible with the presuppositional behaviors of $\ulcorner x\ \mathit{Vs}\ \mathit{that}\ p \urcorner$, given a unified account of the interpretations of $\ulcorner x\ \mathit{Vs}\ Q \urcorner$ and $\ulcorner x\ \mathit{Vs}\ \mathit{that}\ p \urcorner$.

(4) a. Max **knows** that Ash smokes.
$\overset{\text{presup}}{\Rightarrow}$ Ash smokes.

b. Max **is certain** that Ash smokes.
$\overset{\text{presup}}{\Rightarrow}$ It is compatible with Max's beliefs that Ash smokes.

c. Max **agrees** with Kim that Ash smokes.
$\overset{\text{presup}}{\Rightarrow}$ Kim believes that Ash smokes.

Proposal: Uniqueness for each answer

Each possible answer of a singular-*which* question presupposes uniqueness.

(5) which student smokes $\rightsquigarrow$

$$\left\{ \begin{array}{c} \lambda w' : \underline{\exists! x[\text{student}_{w'}(x) \wedge \text{smoke}_{w'}(x)]}.\ \text{smoke}_{w'}(a), \\ \lambda w' : \underline{\exists! x[\text{student}_{w'}(x) \wedge \text{smoke}_{w'}(x)]}.\ \text{smoke}_{w'}(b), \\ \lambda w' : \underline{\exists! x[\text{student}_{w'}(x) \wedge \text{smoke}_{w'}(x)]}.\ \text{smoke}_{w'}(c) \end{array} \right\}$$

cf. Rullmann&Beck (1998); Champolion et al. (2017)

Combining this treatment of uniqueness together with the existential semantics of question-embedding (Spector&Egre 2015) accounts for the projection patterns.

Data and problems for existing accounts

With factive predicates

(6) a. Max doesn't **know** which student smokes.

b. Does Max **know** which student smokes?

c. If Max **knows** which student smokes, ...

$\overset{\text{presup}}{\Rightarrow}$ 'Exactly one student smokes.'

(7) a. Max isn't **surprised** (about) which student smokes.

b. Is Max **surised** (about) which student smokes?

c. If Max is **surprised** (about) which student smokes, ...

$\overset{\text{presup}}{\Rightarrow}$ 'Exactly one student smokes.'

With factive predicates

The uniqueness presupposition projects to the matrix level.

Ans: presupposes Q contains the strongest true answer

$$\mathsf{Ans}_w = \lambda Q_{\langle st,t\rangle}.\iota p[p \in Q \wedge p(w) \wedge \forall p' \in Q[p'(w) \rightarrow p \subseteq p']]$$

The denotation of a singular *which*-question consists of 'atomic' answers. For every w, Ans_w is defined for such a question only if exactly one of its answers is true in w.

(8) which student smokes $\rightsquigarrow$
$\{ \lambda w'.\mathsf{smk}_{w'}(a), \lambda w'.\mathsf{smk}_{w'}(b), \lambda w'.\mathsf{smk}_{w'}(c) \}$ $\quad (=: Q)$

(9) Max **knows** which student smokes $\rightsquigarrow$
$\mathsf{know}_w(\mathsf{m}, \mathsf{Ans}_w(Q))$

(9) is defined only if $\mathsf{Ans}_w(Q)$ is defined
$\Leftrightarrow$ 'Exactly one student smokes.'

Problem with an Ans-based account: *be certain*

(10) a. Max isn't **certain** (about) which student smokes.

b. Is Max **certain** (about) which student smokes?

c. If Max **is certain** (about) which student smokes, ...

$\overset{\text{presup}}{\not\Rightarrow}$ 'Exactly one student smokes.'

$\overset{\text{presup}}{\Rightarrow}$ 'Max believes that exactly one student smokes.'

(11) No student smokes. But, Max believes that there is a student smoker. Only, he {**isn't certain**/#**doesn't know**} which student smokes.

With *be certain*

The uniqueness presupposition projects to the subject's beliefs.

Naturally-occurring example with *be certain*

(12) Every blinking light, every bell and every Christmas carol has a beauty to a child which we are unable to remember. So, what if the lights blow a fuse? Does it really matter if the bells are a little bit dented or not in tune? Who cares if you've heard the same song 500 times? Even if you see a dozen Santas in a day, every new meeting with Santa Claus is special. Santa Claus can't be everywhere so he has helpers (of course!), but how can a child be certain which Santa is real? It isn't possible, so he or she treats them all with equal awe and love. ('The Lafayette' Vol. 114, No. 12)

$\overset{\text{presup}}{\not\Rightarrow}$ 'Exactly one Santa is real.'

$\overset{\text{presup}}{\Rightarrow}$ 'A child believes that exactly one Santa is real.'

Incorrect prediction under the Ans-based account

Problem with the Ans-based analysis

The uniqueness presupposition is predicted to project to the matrix level, regardless of the embedding predicate.

(13) Max **knows** which student smokes $\rightsquigarrow$
$\mathsf{know}_w(\mathsf{m}, \mathsf{Ans}_w(Q))$

(14) Max **is certain** about which student smokes $\rightsquigarrow$
$\mathsf{certain}_w(\mathsf{m}, \mathsf{Ans}_w(Q))$

- (14) is defined only if $\mathsf{Ans}_w(Q)$ is defined
  $\Leftrightarrow$ 'Exactly one student smokes.'

Ans as part of the verb-meaning

Question-embedding predicates relate the subject's attitude representation to **Ans**(Q) in different ways.

(15) knows $\rightsquigarrow \lambda Q \lambda x.\mathbf{know}_w(x, \mathbf{Ans}_w(Q))$

(16) be certain $\rightsquigarrow \lambda Q \lambda x.\forall v[v \in \mathbf{Dox}_x^w \rightarrow \mathbf{certain}_w(x, \mathbf{Ans}_v(Q))]$

(17) Max is certain which student smokes $\rightsquigarrow$
$\forall v[v \in \mathbf{Dox}_{\mathbf{m}}^w \rightarrow \mathbf{certain}_w(\mathbf{m}, \mathbf{Ans}_v(Q))]$

- Assuming universal projection out of universally quantified statements, (17) is defined only if $\forall v[v \in \mathbf{Dox}_{\mathbf{m}}^w \rightarrow \mathbf{Ans}_v(Q)$ is defined]
$\Leftrightarrow$ 'Max believes that exactly one student smokes.'

Problem with "Ans in the predicate meaning"

Not straightforward to have a *unified* account for the presuppositions of $\ulcorner x\ Vs\ Q \urcorner$ and $\ulcorner x\ Vs\ that\ p \urcorner$ across different predicates.

(18) a. Max is certain (about) *Q*
$\overset{\text{presup}}{\Rightarrow}$ M believes that *Q* has a strongest true member.

b. Max is certain that *p*
$\overset{\text{presup}}{\Rightarrow}$ *p* is *compatible* with Max's beliefs.

(19) a. Max agrees with Kim on *Q*
$\overset{\text{presup}}{\Rightarrow}$ Max and Kim believe that *Q* has a strongest true member.

b. Max agrees with Kim that *p*
$\overset{\text{presup}}{\Rightarrow}$ Kim believes *p*.

Problem for Uegaki (2015): *be certain-that*

Uniform analysis of complementation (Uegaki 2015; Theiler et al. 2018)

A declarative complement denotes the singleton set consisting of the proposition it classically denotes.

(20) Max is certain that Ash smokes $\rightsquigarrow$

$$\forall v[v \in \mathbf{Dox}_{\mathrm{m}}^{w} \rightarrow \mathbf{certain}_w(\mathrm{m}, \mathbf{Ans}_v(\{A\}))]$$

- $\mathbf{Ans}_v(\{A\})$ is defined only if $A(v)$.
- (20) is defined only if $\forall v[v \in \mathbf{Dox}_{\mathrm{m}}^{w} \rightarrow \mathbf{Ans}_v(\{A\})$ is defined]
  $\Leftrightarrow \forall v[v \in \mathbf{Dox}_{\mathrm{m}}^{w} \rightarrow A(v)]$
- This presupposition seems too strong.
- Rather, (20) seems to presupposes that it is compatible with M's beliefs that A smokes.

(21) Does Max **agree** with Kim on which student smokes?

1. $\overset{\text{presup}}{\Rightarrow}$ Kim believes that exactly one student smokes.
2. $\overset{\text{presup}}{\Rightarrow}$ Max believes that exactly one student smokes.

Uegaki (2015)-style analysis of *agree-wh*:

(22) ⌜x agrees with y on Q⌝ presupposes:

1. y believes that Q has a strongest true member.
2. x believes that Q has a strongest true member.

Problem for Uegaki (2015): *agree* (cont.)

(23) **Prediction**: x agrees with y that p presupposes:

1. y believes that $\{p\}$ has a strongest true member.
2. x believes that $\{p\}$ has a strongest true member.

   $\Rightarrow$ presupposes that both x and y believe that p.

(24) Does Max **agree** with Kim that Ash smokes?
$\overset{\text{presup}}{\Rightarrow}$ Kim believes that Ash smokes.
$\overset{\text{presup}}{\not\Rightarrow}$ Max believes that Ash smokes.

- The uniqueness presupposition projecting to the subject's belief appears in *agree-wh* but not in *agree-that*.

The traditional Ans-based analysis (cf. Dayal 1996)

- $x\ Vs\ Q \rightsquigarrow V_w(x, \mathsf{Ans}_w(Q))$
- Problem: Uniqueness does not always project to the matrix level. E.g., Uniqueness projects to the subject's beliefs with *be certain*.

Ans as part of the predicate meaning (Uegaki 2015)

- *be certain* $\rightsquigarrow \lambda Q \lambda x. \forall v[v \in \mathsf{Dox}_x^w \rightarrow \mathsf{certain}_w(x, \mathsf{Ans}_v(Q))]$
- Problem: Not straightforward to extend the account to the presuppositions of $\ulcorner x\ Vs\ that\ p \urcorner$ in a unified manner across predicates.

Proposal: uniqueness for each answer

Proposal: Uniqueness for each answer

Each possible answer of a singular-*which* question presupposes uniqueness.

(25) which student smokes $\leadsto$

$$\left\{ \begin{array}{l} \lambda w' : \underline{\exists! x[\text{student}_{w'}(x) \wedge \text{smoke}_{w'}(x)]}.\ \text{smoke}_{w'}(a), \\ \lambda w' : \underline{\exists! x[\text{student}_{w'}(x) \wedge \text{smoke}_{w'}(x)]}.\ \text{smoke}_{w'}(b), \\ \lambda w' : \underline{\exists! x[\text{student}_{w'}(x) \wedge \text{smoke}_{w'}(x)]}.\ \text{smoke}_{w'}(c) \end{array} \right\}$$

Existential semantics for question-embedding

$\ulcorner x\ Vs\ Q \urcorner \leadsto \exists p \in \mathrm{Q}[\mathrm{V}_w(x, p)]$ (George 2011; Spector&Egré 2015)

Illustration with the definite DP in wh-complements

(26) who caught the unicorn $\rightsquigarrow$

$$\left\{ \begin{array}{c} \lambda w' : \underline{\exists! x[\textsf{unicorn}_{w'}(x)]}.\ \textsf{caught}_{w'}(a, x), \\ \lambda w' : \underline{\exists! x[\textsf{unicorn}_{w'}(x)]}.\ \textsf{caught}_{w'}(b, x), \\ \lambda w' : \underline{\exists! x[\textsf{unicorn}_{w'}(x)]}.\ \textsf{caught}_{w'}(c, x) \end{array} \right\}$$

(27) a. Max knows who caught the unicorn.
$\overset{\text{presup}}{\Rightarrow}$ There is a unique unicorn.

b. Max is certain who caught the unicorn.
$\overset{\text{presup}}{\Rightarrow}$ Max believes that there is a unique unicorn.

c. Max agrees with Kim on who caught the unicorn.
$\overset{\text{presup}}{\Rightarrow}$ Max believes that there is a unique unicorn.
$\overset{\text{presup}}{\Rightarrow}$ Kim believes that there is a unique unicorn.

(28) a. Max **knows** that the unicorn danced.
$\overset{\text{presup}}{\Rightarrow}$ There is a unique unicorn & that it danced & Max believes that there is a unique unicorn.

b. Max **is certain** that the unicorn danced.
$\overset{\text{presup}}{\Rightarrow}$ M believes there is a unique unicorn & it is compatible with M's beliefs that it danced.

c. Max **agrees** with Kim that the unicorn danced.
$\overset{\text{presup}}{\Rightarrow}$ Both Max and Kim believe that there is a unique unicorn & Kim believes that it danced.

(29) a. $\mathsf{know}_w(x, p_\pi) \overset{\text{presup}}{\Rightarrow} \pi(w) \wedge \mathsf{Dox}_w^x \subseteq \pi \wedge p(w)$

b. $\mathsf{certain}_w(x, p_\pi) \overset{\text{presup}}{\Rightarrow} \mathsf{Dox}_w^x \subseteq \pi \wedge \mathsf{Dox}_w^x \cap p \neq \varnothing$

c. $\mathsf{agree}_w(x, y, p_\pi)$
$\overset{\text{presup}}{\Rightarrow} \mathsf{Dox}_w^x \subseteq \pi \wedge \mathsf{Dox}_w^y \subseteq \pi \wedge \mathsf{Dox}_w^y \subseteq p$

- which student smokes $\rightsquigarrow \{A_\pi, B_\pi, C_\pi, ...\}$
- $\pi := \lambda w.\exists! x[\textbf{student}_w(x) \wedge \textbf{smoke}_w(x)]$
- **Existential projection**: $\exists x[P(x)] \overset{\text{presup}}{\Rightarrow} \exists x[P(x) \text{ is defined}]$

(30) Max knows which student smokes. $\rightsquigarrow$

$\exists p_\pi \in Q[\textbf{know}_w(\textbf{m}, p_\pi)]$

$\overset{\text{presup}}{\Rightarrow} \exists p_\pi \in Q[\textbf{know}_w(\textbf{m}, p_\pi) \text{ is defined}]$ (∃-projection)

$\Rightarrow \exists p_\pi \in Q[\pi(w) \wedge p(w) \wedge \textbf{Dox}^w_\textbf{m} \subseteq \pi]$

(presup of $\textbf{know}_w(x, p)$)

$\Leftrightarrow \pi(w) \wedge \exists p_\pi \in Q[p(w)] \wedge \textbf{Dox}^w_\textbf{m} \subseteq \pi$

'Exactly one student smokes and some student smokes and Max believes that exactly one student smokes.'

(31) Max is certain which student smokes. $\rightsquigarrow$

$\exists p_\pi \in Q[\textbf{certain}_w(\text{m}, p_\pi)]$

$\overset{\text{presup}}{\Rightarrow} \exists p_\pi \in Q[\textbf{certain}_w(\text{m}, p_\pi) \text{ is defined}]$ (∃-projection)

$\Rightarrow \exists p_\pi \in Q[\textbf{Dox}^{\textbf{m}}_w \subseteq \pi \wedge \textbf{Dox}^{\textbf{m}}_w \cap p \neq \varnothing]$

(presup of $\textbf{certain}_w(x, p)$)

$\Leftrightarrow \textbf{Dox}^{\textbf{m}}_w \subseteq \pi \wedge \exists p_\pi[\textbf{Dox}^{\textbf{m}}_w \cap p \neq \varnothing]$

'Max believes that exactly one student smokes & There is a student s.t. their smoking is compatible with Max's beliefs'.

(32) Max agrees with Kim on which student smokes. $\rightsquigarrow$

$\exists p_\pi \in Q[\mathsf{agree}_w(\mathsf{m}, \mathsf{k}, p_\pi)]$

$\overset{\text{presup}}{\Rightarrow} \exists p_\pi \in Q[\mathsf{agree}_w(\mathsf{m}, \mathsf{k}, p_\pi)$ is defined] (∃-projection)

$\Rightarrow \exists p_\pi \in Q[\mathsf{Dox}^{\mathsf{m}}_w \subseteq \pi \wedge \mathsf{Dox}^{\mathsf{k}}_w \subseteq \pi \wedge \mathsf{Dox}^{\mathsf{k}}_w \subseteq p]$

(presup of $\mathsf{agree}_w(x, y, p)$)

$\Leftrightarrow \mathsf{Dox}^{\mathsf{m}}_w \subseteq \pi \wedge \mathsf{Dox}^{\mathsf{k}}_w \subseteq \pi \wedge \exists p_\pi \in Q[\mathsf{Dox}^{\mathsf{k}}_w \subseteq p]$

‘M believes that exactly one student smokes &
K believes that exactly one student smokes &
there is a student s.t. K believes they smoke’

$\Leftrightarrow$ ‘M believes that exactly one student smokes &
there is exactly one student s.t. K believes they smoke’.

(33) Which student smokes?
$\overset{\text{presup}}{\Rightarrow}$ 'Exactly one student smokes.'

- In the matrix case, I assume that there is an additional presupposition that at least one answer is true.
- Together with the uniqueness presupposition of the answers, this presupposition guarantees that a matrix singular-*which* question also presupposes uniqueness.

Compositional implementations

Existential question-taking semantics for the predicates

$V \rightsquigarrow \lambda Q_{\langle st,t\rangle} \lambda x.\exists p \in Q[V_w(x,p)]$

Two ways to derive uniqueness

1. Redefine **Ans** so that it adds the uniqueness presupposition to each answer in the Hamblin denotation.
2. Encode the presupposition to *which*.
(cf. Rullmann&Beck 1998; Champolion et al. 2017)

Redefined Ans-operator

$\text{Ans}' := \lambda Q_{\langle st,t\rangle}\ \{\, p \mid \exists p' \in Q[p = \lambda w\colon\ \text{AnsD}_w(Q) \text{ is defined}.\ p'] \,\}$

$(\text{AnsD}_w := \lambda Q_{\langle st,t\rangle}.\iota p[p \in Q \wedge p(w) \wedge \forall p' \in Q[p'(w) \rightarrow p \subseteq p']])$

(34) $\text{Ans}'\{A, B, C\} = \left\{ \begin{array}{c} \lambda w\colon\ \text{AnsD}_w\{A, B, C\} \text{ is defined}.\ A, \\ \lambda w\colon\ \text{AnsD}_w\{A, B, C\} \text{ is defined}.\ B, \\ \lambda w\colon\ \text{AnsD}_w\{A, B, C\} \text{ is defined}.\ C \end{array} \right\}$

(35) Max knows [Ans′ [which student smokes]] $\rightsquigarrow$
$[\lambda Q_{\langle st,t\rangle} \lambda x.\exists p \in Q[\text{know}_w(x, p)]](\text{Ans}'\{A, B, C\})(\text{m})$
$\equiv \exists p \in (34)[\text{know}_w(\text{m}, p)]$

This preserves existing results of AnsD :

- The existential presupposition for plural-*which* questions.
- The presupposition of alternative questions.
- Account of negative islands (Fox&Hackl 2006)

An open issue

(36) John knows that the unicorn danced.
$\overset{\text{presup}}{\Rightarrow}$ John believes that there is a unique unicorn.

Prediction:

(37) Max knows which student smokes.
$\overset{\text{presup}}{\Rightarrow}$ Max believes that exactly one student smokes.

This presupposition seems to be too strong in negated cases and polar questions:

(38) Max doesn't know which student smokes.
??? $\overset{\text{presup}}{\Rightarrow}$ Max believes that exactly one student smokes.

(39) Does Max know which student smokes.
??? $\overset{\text{presup}}{\Rightarrow}$ Max believes that exactly one student smokes.

Conclusions

The projection pattern of the uniqueness presupposition of singular *which*-questions in $\ulcorner x\ Vs\ Q \urcorner$ is accounted for by assuming that each possible answer presupposes uniqueness, given the presupposition projection behaviors of $x\ Vs\ that\ p$.

(40) which student smokes $\rightsquigarrow$

$$\left\{ \begin{array}{c} \lambda w' : \underline{\exists! x[\text{student}_{w'}(x) \wedge \text{smoke}_{w'}(x)]}. \text{smoke}_{w'}(a), \\ \lambda w' : \underline{\exists! x[\text{student}_{w'}(x) \wedge \text{smoke}_{w'}(x)]}. \text{smoke}_{w'}(b), \\ \lambda w' : \underline{\exists! x[\text{student}_{w'}(x) \wedge \text{smoke}_{w'}(x)]}. \text{smoke}_{w'}(c) \end{array} \right\}$$

Appendix

(41) $\textit{know} \rightsquigarrow$
$\lambda Q_{\langle st,t\rangle} \lambda x_e.\ \exists p[p \in \mathbf{Res}(\{\, p \mid p(w)\,\})(Q) \wedge \mathbf{Dox}_x^w \subseteq p]$

(42) $\textit{be certain} \rightsquigarrow \lambda Q_{\langle st,t\rangle} \lambda x_e.$
$\exists p[p \in \mathbf{Res}(\{\, p \mid p \cap \mathbf{Dox}_x^w \neq \varnothing\,\})(Q) \wedge \mathbf{Dox}_x^w \subseteq p]$

(43) $\textit{agree} \rightsquigarrow \lambda Q_{\langle st,t\rangle} \lambda y_e \lambda x_e.$
$\exists p[p \in \mathbf{Res}(\{\, p \mid \mathbf{Dox}_y^w \subseteq p\,\})(Q) \wedge \mathbf{Dox}_x^w \subseteq p]$

(44) $\mathbf{Res}(C_{\langle st,t\rangle}) = \lambda Q_{\langle st,t\rangle} :\ \exists p \in Q \cap C.$
$\{\, p \in C \cap Q \mid \neg\exists p' \in Q \cap C[p' \Rightarrow p \wedge p' \not\Leftarrow p]\,\}$

(45) that p $\rightsquigarrow \{p\}$

(cf. Lahiri 2002; Cremers 2016; Uegaki 2015; Xiang 2016)