On the selectional restrictions of clause-embedding predicates

Floris Roelofsen

This talk is to a large extent based on joint work with Maria Aloni, Ivano Ciardelli, and especially Nadine Theiler

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Some predicates take both declarative and interrogative complements:

(1)  
   a. Bill knows that Mary left.  
   b. Bill knows whether Mary left / who left.
Some predicates take **both** declarative and interrogative complements:

(1)   a. Bill **knows** that Mary left.
     b. Bill **knows** whether Mary left / who left.

Others take **only interrogative** complements:

(2)   a. *Bill **wonders** that Mary left.
     b. Bill **wonders** whether Mary left / who left.
Some predicates take both declarative and interrogative complements:

(1)  a. Bill knows that Mary left.
     b. Bill knows whether Mary left / who left.

Others take only interrogative complements:

(2)  a. *Bill wonders that Mary left.
     b. Bill wonders whether Mary left / who left.

Yet others only declarative complements:

(3)  a. Bill believes that Mary left.
     b. *Bill believes whether Mary left / who left.
## TWO APPROACHES

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<th>TYPE DISTINCTION</th>
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Today:

1. Briefly discuss some limitations of the *type*-based approach
2. Survey some recent *uniform* accounts of
   - Anti-rogatives: *believe, hope*
   - Rogatives: *wonder, depend on*
3. Highlight some open issues that need to be investigated further
PART 1

Limitations of the type-based approach
Many authors assume a type-distinction between declarative and interrogative complements.

More specifically, it is usually assumed that:

- Declarative complements are of type $\langle s,t \rangle$
- Interrogative complements are of type $\langle \langle s,t \rangle,t \rangle$

Karttunen (1977); Heim (1994); Dayal (1996); Beck and Rullmann (1999)
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Assuming such a distinction, one could account for selectional restrictions by stipulating that:

- anti-rogatives only take complements of type \( \langle s, t \rangle \)
- rogatives only take complements of type \( \langle \langle s, t \rangle, t \rangle \)
LIMITATION 1: TYPE-SHIFTING OBVIATES CLASH

John knows that Mary arrived \langle s,t \rangle and he knows what she brought \langle \langle s,t \rangle ,t \rangle
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LIMITATION 1: TYPE-SHIFTING OBVIATES CLASH

We lose the account of *wonder*that

John \textbf{knows} that Mary arrived \langle s,t \rangle
and he \textbf{knows} what she brought \langle \langle s,t \rangle,t \rangle

We lose the account of *believe*wh

A type-based account cannot directly capture the selectional restrictions of both rogatives and anti-rogatives at once.
LIMITATION 2: EXPLANATORY VALUE

- It needs to be stipulated which predicates take complements of type \(〈s,t〉\) and which take complements of type \(〈〈s,t⟩,t⟩\).
- Therefore, the account only has explanatory value to the extent that these stipulations can be independently motivated.

That is, we want to link the selectional restrictions of (anti-)rogatives to independently observable semantic properties of these predicates.
LIMITATION 2: EXPLANATORY VALUE

- It needs to be stipulated which predicates take complements of type $\langle s,t \rangle$ and which take complements of type $\langle \langle s,t \rangle, t \rangle$.
- Therefore, the account only has explanatory value to the extent that these stipulations can be independently motivated.
- Uegaki (2015a) suggests that a type-distinction between know and believe could indeed be independently motivated.
- But Theiler et al. (2018) discuss a number of open issues for this line of motivation.
- Perhaps these issues can be resolved. But as long as they remain open, the type-based approach has limited explanatory value.
PART 2

Anti-rogatives
Likelihood predicates: e.g., *seem*, *be likely*

Epistemic attitude predicates: e.g., *believe*, *think*, *feel*

Preferential attitude predicates: e.g., *want*, *desire*, *hope*

Truth-evaluating predicates: e.g., *be true*, and *be false*

Speech act predicates: e.g., *claim*, *suggest*
ANTI-ROGATIVES: INITIAL CLASSIFICATION

1. Likelihood predicates: e.g., *seem, be likely*
2. Epistemic attitude predicates: e.g., *believe, think, feel*
3. Preferential attitude predicates: e.g., *want, desire, hope*
4. Truth-evaluating predicates: e.g., *be true, and be false*
5. Speech act predicates: e.g., *claim, suggest*

- Why would such verbs not license interrogative complements?
- Do they have some semantic property in common from which this may be derived?
So far, no unique semantic property has been identified that is common to all anti-rogative predicates.

However, it has been observed that several sub-classes do have common semantic properties which may explain their anti-rogativity.

In particular:

- All *neg-raising* predicates are anti-rogative. 
  
  (Zuber, 1982)

- All *non-veridical preferential* predicates are anti-rogative.
  
  (Uegaki and Sudo, 2017)
These two properties together cover three classes on our list:

1. Likelihood predicates: e.g., seem, be likely
2. Epistemic attitude predicates: e.g., believe, think, feel
3. Preferential attitude predicates: e.g., want, desire, hope
4. Truth-evaluating predicates: e.g., be true, and be false
5. Speech act predicates: e.g., claim, suggest

All elements of class (1) and (2) and some of class (3) are neg-raising.
All elements of class (3) are non-veridical preferential.
Furthermore, recent work has argued that anti-rogativity can indeed be derived from each of these two properties. (Theiler et al., 2016, 2017, 2018; Uegaki and Sudo, 2017, 2018; Mayr, 2017; Cohen, 2017)

I will illustrate how this can be done (without going into all the details).
Bartsch (1973) and Gajewski (2007) have argued that neg-raising predicates carry an excluded middle presupposition.

(4) John believes that Mary left.
    ~John believes that Mary left or he believes that she didn’t leave.
Bartsch (1973) and Gajewski (2007) have argued that neg-raising predicates carry an excluded middle presupposition.

(4) \[ \text{John believes that Mary left.} \]
\[ \neg \text{John believes that Mary left or he believes that she } \text{didn’t leave.} \]

- In (4), the presupposition is \textbf{weaker} than the asserted content.
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- In (4), the presupposition is weaker than the asserted content.
- But under negation, presupposed and asserted content become logically independent.

(5) John doesn’t believe that Mary left.
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(5) John doesn’t believe that Mary left.
    $\sim$ John believes that Mary left or he believes that she didn’t leave.

- Together they imply that John believes Mary didn’t leave.
\[
\left[ \text{believe} \right]^w = \lambda P_{(st,t)}. \lambda x : \ \text{dox}^w_x \in P \lor \text{dox}^w_x \in \neg P. \text{dox}^w_x \in P
\]
COMBINING THE EXCLUDED MIDDLE PRESUPPOSITION WITH A UNIFORM TREATMENT OF CLAUSAL COMPLEMENTS

\[ \llbracket \text{believe} \rrbracket^w = \lambda P_{(s,t)} \cdot \lambda x : \begin{array}{c} \text{dox}_x^w \in P \lor \text{dox}_x^w \in \neg P \end{array}. \text{dox}_x^w \in P \]

The negation is inquisitive negation:

\[ \neg P := \{ p \mid \forall q \in P : p \cap q = \emptyset \} \]

For example:

\[ P = \begin{array}{c} \square \end{array} \quad \neg P = \begin{array}{c} \bullet \bullet \end{array} \]
The negation is **inquisitive negation**:

\[-P := \{ p \mid \forall q \in P : p \cap q = \emptyset \}\]

For example:

\[
P = \\
\neg P = \\
\]

The effect of this presupposition depends on whether \( P \) is a declarative or an interrogative complement.
If $P$ is the semantic value of a declarative complement, it contains only one alternative $q$. 
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\circ \\
\circ \\
\circ 
\end{array}$$
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\circ \\
\circ \\
\circ
\end{array} \]

\[ \llbracket \text{believe}(P)(x) \rrbracket^w = 1 \text{ iff } \text{dox}_x^w \in P \]
\[ \text{iff } \text{dox}_x^w \subseteq q \]
If $P$ is the semantic value of a declarative complement, it contains only one alternative $q$.

\[ P = \begin{array}{ccc} 0 & 0 & 0 \\ \end{array} \quad -P = \begin{array}{ccc} 1 & 1 & 1 \\ \end{array} \]

\[
[\text{believe}(P)(x)]^w = 1 \iff \text{dox}_x^w \in P
\]
\[
\iff \text{dox}_x^w \subseteq q
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Presupposition: $\text{dox}_x^w \in P \lor \text{dox}_x^w \in \neg P$
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$x$ is certain that $q$ is true
If $P$ is the semantic value of a declarative complement, it contains only one alternative $q$.

\[
P = \begin{bmatrix}
  \circ \\
  \circ \\
  \circ 
\end{bmatrix}
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\text{iff } \text{dox}_x^w \subseteq q
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Presupposition: $\text{dox}_x^w \subseteq q$ $\lor$ $\text{dox}_x^w \cap q = \emptyset$

$x$ is certain that $q$ is true

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If $P$ is the meaning of an *interrogative complement*, it covers the entire logical space.
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$$P = \begin{array}{c|c|c} & & \\ \hline & & \\ \hline & & \\ \hline & & \end{array}$$

$$\neg P = \{\emptyset\}$$
BELIEVE WITH INTERROGATIVE COMPLEMENTS

If $P$ is the meaning of an **interrogative complement**, it covers the entire logical space.

$$P = \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix} \quad \neg P = \{\emptyset\}$$

$$[[\text{believe}(P)(x)]^w = \text{dox}_x^w \in P$$

**Presupposition:** $\text{dox}_x^w \in P \lor \text{dox}_x^w \in \neg P$
If $P$ is the meaning of an interrogative complement, it covers the entire logical space.

\[ P = \begin{array}{ccc} & & \\
& & \\
& & 
\end{array} \quad \neg P = \{\emptyset\} \]

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vacuous
Believe with Interrogative Complements

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Presupposition:

$$\text{dox}_x^w \in P \lor \text{dox}_x^w \in \{\emptyset\}$$

Identical!

Vacuous
If $P$ is the meaning of an **interrogative complement**, it covers the entire logical space.

$$P = \{\emptyset\} \quad \neg P = \{\emptyset\}$$

**Presupposition:**

$$\text{dox}_x^w \in P \lor \text{dox}_x^w \in \{\emptyset\}$$

Whenever $[\text{believe}^w(P)(x)]$ is defined, it is true. In other words, its assertive content is **trivial relative to its presupposition**.
This **triviality is systematic**: it arises independently of the specific predicate and the specific complement—as long as the predicate is **neg-raising** and the complement **interrogative**.
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- Gajewski (2002, 2008) proposes a notion that delineates systematic from non-systematic triviality: **L-analyticity**.
This **triviality is systematic**: it arises independently of the specific predicate and the specific complement—as long as the predicate is **neg-raising** and the complement **interrogative**.

- Gajewski (2002, 2008) proposes a notion that delineates systematic from non-systematic triviality: **L-analyticity**.
- **L-analyticity**, he argues, is perceived as **ungrammaticality**:
  
  (6)  
  Every table is a table. ‘plain’ tautology
  
  (7)  
  *There is every table in the kitchen. L-analytical

- Theiler *et al.* (2017) show that **neg-raising** predicates with **interrogative** complements always yield **L-analyticity**.
• Non-veridical preferential predicates are anti-rogative:
  (Uegaki and Sudo, 2017)

(8)  a. Bill hopes / wishes that Mary left.
     b. *Bill hopes / wishes whether Mary left.
     c. *Bill hopes / wishes who left.

• By contrast, veridical preferential predicates, aka emotive factives are only anti-rogative to a milder degree.

• They generally license wh-complements (except regret), though whether-complements are still bad:

(9)  a. Bill is happy / surprised that Mary left.
     b. *Bill is happy / surprised (about) whether Mary left.
     c. Bill is happy / surprised (about) who left.
Can this pattern be derived from the semantics of preferential predicates?

To see this, let us try to identify some general semantic properties of preferential predicates.

First, consider cases with a declarative complement:

(10) Bill hopes that Mary left.
(11) Bill is happy that Mary left.

When taking a declarative complement, preferential predicates convey that the proposition $p$ expressed by the complement is in some sense preferable w.r.t. a set of alternatives for $p$.

The relevant set of alternatives $C$ is contextually determined, constrained by focus.

(Heim, 1994; Villalta, 2008, among others)
Now let’s consider a case with an **interrogative complement**.

We have to look at a veridical predicate because non-veridicals don’t license interrogative complements.

(12) Bill is happy (about) who left.

Here, the predicate conveys that the true answer $p$ to the question expressed by the complement is preferred w.r.t. other answers to the question.

So again, one proposition $p$, determined by the complement, is compared to a set of alternative propositions $C$, again partly determined by the complement.
Romero (2015) and Uegaki and Sudo (2017) formalise this roughly as follows (I am simplifying here):

\[ \llbracket \text{be happy}_C \rrbracket^w = \lambda Q_{(s,t)}. \lambda x. \]

\[ \exists p \in Q( p(w) \land \text{PREF}_x^w(p) > \text{AVE}(\{\text{PREF}_x^w(p') : p' \in C\}) ) \]

(13) Bill is happy that Mary left.

(14) Bill is happy (about) who left.
Uegaki and Sudo (2017) extend this to non-veridicals and note that this semantics predicts anti-rogativity:

\[
\llbracket \text{hope}_C \rrbracket^w = \lambda Q_{(st,t)} \cdot \lambda x. \\
\exists p \in Q(p(w) \land \text{Pref}^w_x(p) > \text{AVE} (\{ \text{Pref}^w_x(p') \mid p' \in C \}))
\]

(15) Bill hopes that Mary left.
(16) *Bill hopes who left.  trivial
ANTI-ROGATIVES OVERVIEW

1. Likelihood predicates: e.g., *be likely*  
   TRA/Mayr
2. Epistemic attitude predicates: e.g., *believe*  
   TRA/Mayr
3. Preferential attitude predicates: e.g., *hope*  
   U&S
4. Truth-evaluating predicates: e.g., *be true*  
   TRA
5. Speech act predicates: e.g., *assert, claim, suggest*

Note that a theory of speech act predicates has to account for the difference between:

- Anti-rogative speech act predicates like *assert, claim, and suggest*;
- Response speech act predicates like *state, announce, and tell*.

This does not seem straightforward.
PART 3

Rogatives
Three subclasses (cf., Karttunen, 1977):

1. Inquisitive predicates: wonder, be curious, investigate
2. Dependency predicates: depend on, be determined by
3. Speech act predicates: ask, inquire
I will outline an account of wonder based on Uegaki (2015b) and Ciardelli and Roelofsen (2015).

Essentially:  

\[ \text{wonder} = \text{not be certain} + \text{want to find out} \]
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Essentially:  *wonder* = *not be certain* + *want to find out*

- To capture this, we need a representation of the things that an individual *would like to know*: her *inquisitive state* \( \text{INQ} \).
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- To capture this, we need a representation of the things that an individual **would like to know**: her inquisitive state \( \text{INQ} \).
- \( \text{INQ}_x^w \) is defined as a downward closed set of consistent information states, those that resolve the issues that \( x \) entertains.
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- To capture this, we need a representation of the things that an individual \textit{would like to know}: her inquisitive state \( \text{INQ} \).
- \( \text{INQ}^w_x \) is defined as a downward closed set of consistent information states, those that resolve the issues that \( x \) entertains.
- Together, the states in \( \text{INQ}^w_x \) cover \( \text{DOX}^w_x \): \( \bigcup \text{INQ}^w_x = \text{DOX}^w_x \)
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- $\text{INQ}_x^w$ is defined as a downward closed set of consistent information states, those that resolve the issues that $x$ entertains.  
- Together, the states in $\text{INQ}_x^w$ cover $\text{DOX}_x^w$: $\bigcup \text{INQ}_x^w = \text{DOX}_x^w$  
- For example:
  
  $\text{DOX}_x^w = \setlength{\fboxsep}{0pt} \fbox{$\begin{array}{c} \text{•} \\
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\[
[wonder]^w := \lambda P. \lambda x. \begin{array}{c}
\text{DOX}^w_x \notin P \\
x \text{ isn’t certain}
\end{array} \quad \land \quad \begin{array}{c}
\forall q \in \text{INQ}^w_x : q \in P \\
\text{but wants to find out}
\end{array}
\]
What happens when wonder takes a declarative complement?
What happens when \textit{wonder} takes a \textbf{declarative complement}? Then:

- \( P \) contains a single maximal proposition \( p \).
\([\text{wonder}]^w := \lambda P. \lambda x. \underbrace{\text{DOX}_x^w \not\in P}_x \text{ isn’t certain} \land \underbrace{\forall q \in \text{INQ}_x^w : q \in P}_\text{but wants to find out}\)

What happens when \textit{wonder} takes a \textbf{declarative complement}?

Then:

- \(P\) contains a single maximal proposition \(p\).

- \textbf{First conjunct:} \(\text{DOX}_x^w \not\subseteq p\)
What happens when *wonder* takes a **declarative complement**?

Then:

- *P* contains a single maximal proposition *p*.

- **First conjunct:** \( \text{DOX}^w_x \not\subseteq p \)

- **Second conjunct:** \( p \) is entailed by all propositions \( q \in \text{INQ}^w_x \), which means that \( \bigcup \text{INQ}^w_x = \text{DOC}^w_x \subseteq p \).
[wonder]^w := \lambda P. \lambda x. \quad \text{DOX}^w_x \not\subseteq P \quad \land \quad \forall q \in \text{INQ}^w_x : q \in P

What happens when \textit{wonder} takes a \textbf{declarative complement}?

Then:

- \textit{P} contains a single maximal proposition \textit{p}.
- \textbf{First conjunct:} \text{DOX}^w_x \not\subseteq p
- \textbf{Second conjunct:} \textit{p} is entailed by all propositions \textit{q} \in \text{INQ}^w_x, which means that \textstyle \bigcup \text{INQ}^w_x = \text{DOC}^w_x \subseteq p.

So: if \textit{wonder} takes a declarative complement, the two conjuncts in the entry for the verb always become \textbf{contradictory}. 
Inquisitive attitudes: e.g., *wonder*, *be curious*  
Uegaki / C&R

Dependency predicates: e.g., *depend on*  
Theiler et al. (2018)

Speech act predicates: e.g., *ask*, *inquire*  
Theiler et al. (2018)

• The account for *depend on* is similar to that for *wonder*.

• For *ask* and *inquire*, we may assume that the reported speech acts involve a sincerity condition requiring that the uttered sentence be inquisitive w.r.t. the common ground. This cannot be satisfied if the complement is declarative.

• A challenging case is the contrast between *be curious* (rogative) and *interest* (responsive).
PART 4

Further issues
We have already seen above that the class of emotive factive predicates are incompatible with whether-complements, but do accept wh-complements.

(17)  
a. *Bill is happy (about) whether Mary left.  
b. Bill is happy (about) who left.

Some potentially relevant semantic properties:

- Speaker factivity  
  Guerzoni (2007)
- Focus sensitivity  
  Romero (2015)
- Require existential presupposition  
  Roelofsen et al. (2016)
- Don’t license NPIs in wh-complements  
  Roelofsen (2018)

It seems that regret does not license interrogative complements at all (see Cremers and Chemla, 2017, for experimental data). Why this would be is an open puzzle (cf., Egré, 2008).
• Certain predicates don’t like whether-complements in positive episodic sentences, while they do under negation:

(18)  a. *Bill is certain whether Mary left.
      b. Bill is not certain whether Mary left.

(19)  a. *Bill said whether Mary left.
      b. Bill didn’t say whether Mary left.

• Mayr (2017) proposes that the environments in which these predicates license whether-complements are exactly those that license NPIs.

• Experimental data in van Gessel et al. (2018) sheds doubt on this generalization.

• Much further work is needed here, both empirically and theoretically.
The selectional restrictions of clause-embedding predicates can, at least in some cases, be derived from independently observable semantic properties of these predicates.

Several issues remain open:

- Anti-rogative *assert/claim* versus responsive *state/announce*
- Rogative *be curious* versus responsive *interest*
- Emotive factives like *surprise*, and especially *regret*
- Polarity sensitive predicates like *be certain*

Moreover, what we have seen is only part of a much wider landscape of selectional puzzles (involving mood, nominal arguments, exhaustivity, pair-list readings, root phenomena like auxiliary inversion and discourse particles, and more).
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Hopefully, we’ll know more by the end of the project!


APPENDIX

A uniform treatment of clausal complements
In inquisitive semantics, both declarative and interrogative sentences denote sets of propositions.
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We refer to maximal elements in a sentence meaning as alternatives.
[be certain]_w = \lambda P_{\langle s, t \rangle}. \lambda x. \text{dox}_x^w \in P
(20) Mary is certain that John left.

\[ \leadsto \text{True in } w \text{ iff } \text{dox}^w_m \subseteq \{w \mid \text{John left in } w\} \]
RESPONSIVE VERBS

\[ \text{set of resolutions of the complement} \quad \text{doxastic state of } x \text{ in } w \]

\[ \llbracket \text{be certain} \rrbracket^w = \lambda P^{<s,t>} \cdot \lambda x. \text{dox}^{x^w}_w \in P \]

(20) Mary is certain that John left.
\[ \leadsto \text{True in } w \text{ iff } \text{dox}^w_m \subseteq \{ w \mid \text{John left in } w \} \]

(21) Mary is certain whether John left.
\[ \leadsto \text{True in } w \text{ iff } \exists p \in \left\{ \{ w \mid \text{John left in } w \}, \{ w \mid \text{John didn’t leave in } w \} \right\} \text{ s.t. } \text{dox}^w_m \subseteq p \]
Even though declarative and interrogative complements have the same type, they are of course still distinguishable: they come apart in their semantic properties.
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This captures the intuition that declaratives provide but don’t request information.
Even though declarative and interrogative complements have the same type, they are of course still distinguishable: they come apart in their semantic properties.

Interrogative complement meanings contain several alternatives, which always cover the entire logical space.

Who left?
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Who left?