Inquisitive Semantics

Part 3/3: Embedded issues

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Clause-embedding predicates fall into three classes: **rogative**, like *wonder*, **anti-rogative**, like *believe*, and **responsive**, like *know* (after Lahiri 2002).

(1) a. Natalia wonders how high Jiehkkevárri is.
b. #Natalia wonders that Jiehkkevárri is 1834 m high.

(2) a. #Natalia believes how high Jiehkkevárri is.
b. Natalia believes that Jiehkkevárri is 1834 m high.

(3) a. Natalia knows how high Jiehkkevárri is.
b. Natalia knows that Jiehkkevárri is 1834 m high.

Rogatives select interrogative complements, anti-rogatives select declarative complements, and responsives are selectionally flexible.

Since Boër (1978), theories have struggled with predicting all three at once. In its bare bones incarnation of Ciardelli, Groenendijk and Roelofsen (2019) and in more frivolous forms like Theiler, Roelofsen and Aloni (2018, 2019), Inquisitive Semantics claims to hold answers.

1 Responsive predicates: True to term

The classical semantics for *know* (or *believe*) as in (3b) has three ingredients:

1 the argument is a classical proposition, a set of worlds, ϕ

2 what the subject knows is a classical proposition, a set of worlds, σ_a

3 the sentence is true iff $\sigma_a \subseteq \phi$

On (a theory based on) the theory of Karttunen (1977), a *wh* clause denotes a set of propositions, so the predicate or the interrogative complement as in (3a) must mutate for the two to fit together.

On the theory of Groenendijk and Stokhof (1984), both *that* clauses and *wh* clauses denote propositions, so responsive predicates are no problem.

On the other hand, in Inquisitive Semantics both *that* clauses and *wh* clauses denote sets of classical propositions, and the three ingredients are:

$1'$ the argument is a set of sets of worlds, ϕ

$2'$ what the subject knows is a classical proposition, a set of worlds, σ_a

$3'$ the sentence is true iff $\sigma_a \in \phi$

As we can see, there is one other difference to the classical semantics in 1–3: Set inclusion ($\sigma_a \subseteq \phi$) is replaced by set membership ($\sigma_a \in \phi$).

> On such an account, the selectional flexibility of responsive predicates is directly predicted, without any type-shifting operations.
> (Theiler, Roelofsen and Aloni 2019)

The uniformity of *that* and *wh* clauses falls out directly from the generally uniform analysis of declaratives and interrogatives in Inquisitive Semantics.

Note that *that* and *wh* clauses are uniform in the Groenendijk and Stokhof (1984) theory too, but the former differ from the latter in that the intensions are *constant* functions to propositions and from root declaratives in that the extensions are propositions, not truth values.

The analysis in $1'$–$3'$ says that to know an issue is for your epistemic state to resolve it, and if it is non-inquisitive, that means that your epistemic state is a subset of its informative content.

To illustrate, consider the issue of what languages Alexandra speaks, assuming three languages in the domain – Catalan, Norwegian and Polish – and the sentence (4):

(4) Alexander knows what languages Alexandra speaks.

The embedded interrogative will normally be intended and understood in the mention-all sense, so its meaning can be depicted as in Figure 1 (in w_1–w_4, Alexandra speaks Catalan, in w_2, w_3, w_5 and w_6, she speaks Norwegian, in w_3, w_4, w_6 and w_7, she speaks Polish; in w_8 she speaks none of these):

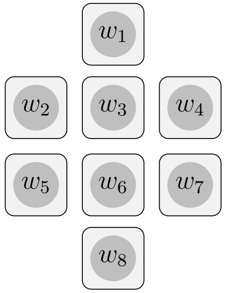

Figure 1: $\forall x\,?\,Sax$

The solid blocks represent the maximal members of the issue – 8 singletons.

In Figure 2 and Figure 3, the dashed block represents Alexander's epistemic state in two different worlds of evaluation, say, w_3 and w_6; (4) is true iff this set of worlds is a subset of one of the maximal members of the issue.

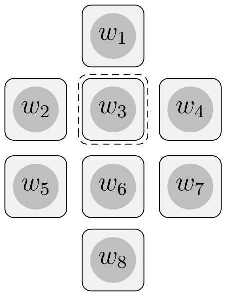

Figure 2: $\sigma_a(w_3) = \{w_3\}$

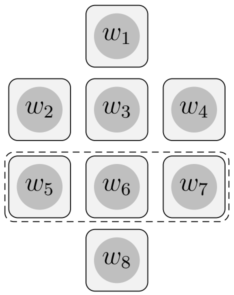

Figure 3: $\sigma_a(w_6) = \{w_5, w_6, w_7\}$

In Figure 2, indeed it is a subset – in fact, Alexander knows that Alexandra speaks all three languages – but in Figure 3, it is not – here, he knows that even though she doesn't speak Catalan she does speak Norwegian or Polish.

> Notice that this treatment of interrogatives embedded under *know*, unlike the ones of Groenendijk and Stokhof (1984) and Karttunen (1977), has no problems dealing with knowledge of mention-some questions. (Ciardelli, Groenendijk and Roelofsen 2019: 153)

(5) is a fair example of an embedded mention-some wh question.

(5) Alexander knows who has a towbar.

Assume that there are three persons in the domain, Huey, June and Louie, and that in w_1–w_4, Huey has a towbar, in w_2, w_3, w_5 and w_6, June has one, and in w_3, w_4, w_6 and w_7, Louie has one; in w_8 none does.

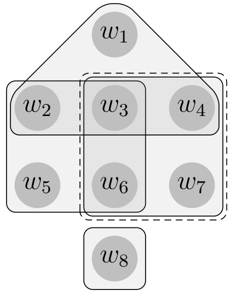

Figure 4: $?\,(\exists\,x\,Tx\,)$, $\sigma_a(w_6) = \{w_3, w_4, w_6, w_7\}$

The dashed block representing Alexander's epistemic state shows that he knows that Louie has a towbar and in virtue of that, (5) is true, although he does not know whether Huey or June has one.

Note that knowing that is exactly like knowing wh only that the complement issue fails to be inquisitive, so that there is just one maximal member, hence the truth condition that the subject's epistemic state is included in at least one maximal member reduces to it being a subset of *the* maximal member.

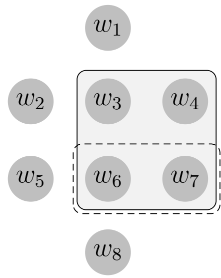

Figure 5: $!\,Tl$, $\sigma_a(w_6) = \{w_6, w_7\}$

Figure 5 illustrates the issue that Louie has a towbar and the circumstance that Alexander knows that (here he even knows that Huey doesn't).

2 Rogative predicates: Inquisitive states

In Inquisitive Semantics, *wh* clauses are not somehow more abstract when they are complements of rogative predicates, as in (6), than when they are complements of responsive predicates, as in (4); but rogatives are analyzed, in terms of the subject's **inquisitive state**, which is an issue.

The semantics of *wonder* has these three ingredients:

1″ the argument is a set of sets of worlds, ϕ

2″ what the subject wonders is a set of sets of worlds as well, Σ_a

3″ the sentence is true iff $\Sigma_a \subseteq \phi$ and $\sigma_a \notin \phi$

In words: For you to wonder, say, whether ϕ, you must not know whether ϕ and anything resolving all the issues you entertain also resolves whether ϕ.

There is an important connection between epistemic states and inquisitive states: For any agent a and any world w,

$$\sigma_a(w) = \bigcup \Sigma_a(w)$$

To illustrate, consider the inquisitive state represented by the solid blocks in Figure 6; the dashed block represents the corresponding epistemic state.

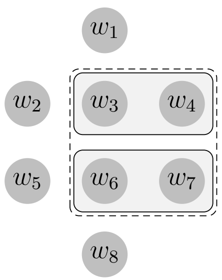

Figure 6: $\Sigma_a(w_6) = ?Ca \wedge Pa$, $\sigma_a(w_6) = Pa$

If that is Alexander's inquisitive state, and Alexandra speaks Catalan in w_1–w_4, Norwegian in w_2, w_3, w_5, w_6, and Polish in w_3, w_4, w_6, w_7, (6) is true:

(6) Alexander wonders whether Alexandra speaks Catalan.

He knows that she speaks Polish, but not whether she also speaks Catalan – in fact, he also does not know whether she speaks Norwegian, but this is an issue he does not entertain.

The second conjunct in 3″ ensures that if you wonder about something, you don't know it, and explains why the argument of *wonder* must be inquisitive; specifically, (7) comes out as a contradiction:

(7) #Alexander wonders that Alexandra speaks Catalan.

Appealing to the notion of L-analyticity (Gajewski 2002), CGR (2019: 157) argue that such sentences are ungrammatical because they are contradictory.

3 Anti-rogative predicates and neg-raising

The negative fact seen in (8) has puzzled people since Boër (1978).

(8) #Alexander believes what languages Alexandra speaks.

Inquisitive Semantics offers a novel account.

> An explanation of the fact that verbs like *believe* and *think* do not take interrogative complements can also be given in inquisitive semantics, see Theiler et al. (2017). (CGR 2019: 157)

Several attempts at explaining that fact have been made outside inquisitive semantics. Some, like Sæbø (2007) or Egré (2008), try to trace it to (non-)factivity, others, like Uegaki (2015), appeal to a type conflict, and yet others, like Mayr (2017), seek to capitalize on the fact, noted by Zuber (1982), that all neg-raising attitude verbs do not take interrogative complements.

The tack taken by Theiler, Roelofsen and Aloni (2017, 2019) is this last one.

The basis is the treatment of neg-raising proposed by Gajewski (2007): Neg-raising verbs carry an *excluded middle* presupposition.

(9) Alexander (doesn't) believe(s) that Alexandra speaks Catalan. ⇝ Alexander has a belief about whether Alexandra speaks Catalan.

(10) is a definition of *believe* building on this in inquisitive semantic terms:

(10) $[\![\, \text{believe} \,]\!]^w = \lambda P_{(st)t}\, \lambda x_e \,:\, \sigma_x(w) \in P \vee \sigma_x(w) \in P^* \,.\, \sigma_x(w) \in P$

where $P^* = \{s \mid s \cap t = \emptyset \text{ for all } t \in P\}$.

Theiler, Roelofsen and Aloni (2019) now argue that when the complement is interrogative so that P is inquisitive, P^* boils down to $\{\emptyset\}$ and hence the second disjunct in the presupposition is redundant, so (10) reduces to (11):

(11) $[\![\text{ believe }]\!]^w = \lambda P_{(st)t}\, \lambda x_e \,:\, \sigma_x(w) \in P \,.\, \sigma_x(w) \in P$

"This means that when *believe* combines with an interrogative complement, its assertive component is trivial relative to its presupposition." The authors go on to argue, appealing to the concept of L-analyticity (Gajewski 2002), that this triviality makes itself felt as ungrammaticality.

Unfortunately, this argument turns on the assumption that an interrogative is never informative, that is, the informative content of the issue it expresses exhausts logical space and is the tautology. As we have seen, however, CGR assume the existence of *hybrid* issues, both informative and inquisitive, and alternative questions are an instance:

(12) #Alexander believes whether Alexandra speaks Catalan or Castilian.

Recall the illustration of the alternative question:

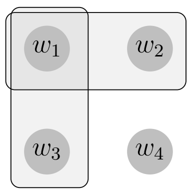

Figure 7: $Ca \vee Sa$

The information state that Alexandra speaks neither Catalan nor Castilian, $\{w_4\}$, is excluded from the issue.

CGR concede that this should ideally be treated as a presupposition – but even so, there will be no triviality in the presuppositions of (12):

Presupposition from the alternative interrogative: $\bigcup(Ca \vee Sa)$
$= \{w_1, w_2, w_3\}$
Presupposition from the anti-rogative verb:
$\lambda w\ \sigma_a(w) \in (Ca \vee Sa)\ \vee\ \sigma_a(w) \in (Ca \vee Sa)^*\ =$
$\lambda w\ \sigma_a(w) \subseteq \{w_1, w_2\}\ \vee\ \sigma_a(w) \subseteq \{w_1, w_3\}\ \vee\ \sigma_a(w) = w_4\ \vee\ \sigma_a(w) = \emptyset$

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