On questions and presuppositions in typed inquisitive semantics

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Abstract

The first part of this talk lays out a compositional account of wh-questions in typed inquisitive semantics (Ciardelli, Roelofsen & Theiler 2017). Relevant issues include multiple *wh*-questions, the interaction between *wh*-items and disjunction, and *de dicto* readings of *which*-questions.

Motivated by the asymmetry between restrictor and nuclear scope of *which*-questions, the second part of this talk takes first steps towards modeling presuppositions of questions in inquisitive semantics.

1 Introduction

- Groenendijk & Stokhof (1984) provided a theory of questions that improved in several respects over Karttunen (1977)
- Basic inquisitive logic (Ciardelli, Groenendijk & Roelofsen 2013) in turn improved in some ways on these theories, but did not preserve all of their achievements

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Feature	K77	GS84	InqB
Compositional derivations	yes	yes	**no**
Interpreting short answers	no	yes	**no**
De dicto readings of *which* questions	no	yes	**no**
Ability to interpret conjoined questions	no	yes	yes
Ability to quantify into questions	no	(yes)	yes
Uniform disjunction across declaratives and interrogatives	no	no	yes
Mention-some readings	no	no	yes
Conditional questions	no	no	yes

- InqB is a first-order logic, and as such does not provide a means to compositionally assign meanings to subsentential constituents. Typed Inquisitive Semantics (Ciardelli, Roelofsen & Theiler 2017) provides the bridge between InqB and compositional semantics. We will build on it here.

- As an intermediate step in the compositional derivation, Groenendijk & Stokhof (1984, 1989) compute the *abstract* of a question—an *n*-place property where *n* is the number of *wh*-words. They use it to interpret short answers:

(1) a. Who walks? — John. *Abstract:* $\lambda x.x$ *walks*
    b. Who loves whom? — John, Mary. *Abstract:* $\lambda y \lambda x.x$ *loves* y

- Typed Inquisitive Semantics gives us the means to compute the abstract of a question.

- Groenendijk & Stokhof (1984) point out that the following inference is invalid when *murderer* is taken *de dicto*:

(2) a. Holmes knows who is tall.
    b. $\not\Rightarrow$ Holmes knows which murderer is tall.

- Karttunen (1977) only generates the *de re* reading. The issue has not been revisited in InqB.

- Some things left for another occasion: NPI licensing in questions (Guerzoni & Sharvit, Nicolae); intervention effects (Beck, Haida, Kotek); cross-linguistic aspects (Shimoyama); superiority effects (Kotek); functional readings; sensitivity to different ways of identifying the individuals in the domain of discourse (Aloni); syntactic restrictions on mention-some readings (Fox, Xiang); pragmatics of mention-some versus mention-all (van Rooij); modals in questions (Spector).

2 Typed inquisitive semantics

- Typed inquisitive semantics is a combination of compositional semantics and basic inquisitive logic.

- Possible worlds ($w, w' \dots$) are primitives (type s). Possibilities ($p, p' \dots$) are sets of possible worlds (type $\langle s, t\rangle$). Inquisitive propositions ($P, P' \dots$) are sets of possibilities (type $\langle st, t\rangle$).

- We abbreviate $\langle e, \langle et\rangle\rangle$ as $\langle e^2, t\rangle$, and $\langle e, \langle e, \langle et\rangle\rangle\rangle$ as $\langle e^3, t\rangle$, etc. We also write $p(x^n)$ for $p(x_1)(x_2)\dots(x_n)$. Similarly, we write $\lambda x^n.b$ for $\lambda x_1 \lambda x_2 \dots x_n.b$; and similarly for quantifiers.

- We let *talks* denote the relation that holds between x and p iff p entails that x talks:

(3) $[\![\text{talks}]\!]_g = \lambda x \lambda p \forall w.p(w) \rightarrow \text{talk}(x)(w)$
$= \lambda x \lambda p.p \subseteq \lambda w.\text{talk}(x)(w)$ type $\langle e, \langle st, t\rangle\rangle$

- We abbreviate $\langle st, t\rangle$ as T. For p_0 a possibility (type $\langle s, t\rangle$), we write $\widehat{p_0}$ for the inquisitive proposition $\lambda p.p \subseteq p_0$. Similarly, for p_n of type $\langle e^n, \langle s, t\rangle\rangle$, we write $\widehat{p_n}$ for $\lambda x_1 \dots \lambda x_n \lambda p.\ p \subseteq \lambda w.p_n(x_1)\dots(x_n)(w)$. For example:

(4) $[\![\text{talks}]\!]_g = \widehat{\text{talk}}$
$= \lambda x \lambda p.p \subseteq \lambda w.\text{talk}(x)(w)$ type $\langle e, T\rangle$

- We represent proper names as constants and use function application to combine meanings:

(5) $[\![\text{John talks}]\!]_g = \widehat{\text{talk}}(j) = \lambda p.p \in \widehat{\text{talk}}(j) = \lambda p.p \subseteq \lambda w.\text{talk}(j)(w)$ type T

3 Propositional connectives

- We assume a type-polymorphic theory of coordination (e.g. Partee & Rooth 1983). Simplifying slightly, define an inquirable type as either the type T or a type $\langle \alpha, \beta\rangle$ where α is any type and β is an inquirable type.

- We define inquisitive negation, $\neg$, as in basic inquisitive semantics, and generalize it to higher types:

(6) a. $\neg_{\langle T,T\rangle} = \lambda P \lambda p.\forall q.P(q) \rightarrow p \cap q = \emptyset$ type $\langle T, T\rangle$
b. $\neg_{\langle \alpha T,\alpha T\rangle} = \lambda P_{\langle \alpha T\rangle} \lambda x_\alpha.\neg_{\langle T,T\rangle} P(x)$ type $\langle \alpha T, \alpha T\rangle$

- We represent the meaning of ordinary linguistic negation via inquisitive negation.

(7) $[\![\text{not}]\!]_g = \lambda P.\neg P$ type $\langle \alpha T, \alpha T\rangle$

For any inquirable type τ we define:

(8) a. $[\![\text{and}]\!]_g = \lambda P_\tau \lambda Q_\tau.P \cap Q$ type $\langle \tau, \tau\tau\rangle$
b. $[\![\text{or}]\!]_g = \lambda P_\tau \lambda Q_\tau.P \cup Q$ type $\langle \tau, \tau\tau\rangle$

- As a special case, we will write $⩕$ (inquisitive conjunction) for the case where we conjoin two terms P and P' of type T, and similarly for $⩖$:

(9) a. $⩕ \overset{\text{def}}{=} \lambda P \lambda P' \lambda p.P'(p) \wedge P(p)$
b. $⩖ \overset{\text{def}}{=} \lambda P \lambda P' \lambda p.P'(p) \vee P(p)$

- Inquisitive conjunction and disjunction share various desirable properties with ordinary conjunction and disjunction, such as idempotence and associativity.
- We assume that proper names can be lifted to generalized quantifiers (note the type):

(10) a. $[\![\text{Lift(John)}]\!]_g = \lambda P_{\langle e,T \rangle}.P(j)$ type $\langle eT, T \rangle$

- We can now interpret *John and Mary walk* and *John or Mary walks*.

(11) a. $[\![\text{Lift(John) and Lift(Mary) walk}]\!]_g = \widehat{\text{walk}}(j) ⩕ \widehat{\text{walk}}(m)$ type T
b. $[\![\text{Lift(John) or Lift(Mary) walks}]\!]_g = \widehat{\text{walk}}(j) ⩖ \widehat{\text{walk}}(m)$ type T

- *John or Mary walks* is interpreted as an inquisitive proposition with two alternatives:

(12) $\widehat{\text{walk}}(j) ⩖ \widehat{\text{walk}}(m) = \lambda p.p \subseteq \lambda w.\text{walk}(j)(w) \vee p \subseteq \lambda w.\text{walk}(m)(w)$

- We can define type-shifted versions of the inquisitive operators ! (noninquisitive closure) and ? (noninformative closure):

(13) $? \overset{\text{def}}{=} \lambda P.P \cup \neg P$ type $\langle \tau, \tau \rangle$

(14) $! \overset{\text{def}}{=} \neg \circ \neg$ type $\langle \tau, \tau \rangle$

- We assume that any declarative sentence with falling intonation contains ! at its root.
- This has the following effect: Where $A ⩖ B$ denotes the set of all possibilities that entail A or entail B, $!(A \vee B)$ denotes the set of all possibilities that entail $A \vee B$, including those that do not entail one of the disjuncts.

(15) $[\![\text{! [John or Mary walk]}]\!]_g$
$= !(\widehat{\text{walk}}(j) ⩖ \widehat{\text{walk}}(m))$ type T
$= \lambda p.p \subseteq \lambda w.\text{walk}(j)(w) \vee \text{walk}(m)(w)$

- Finally, we can define inquisitive quantifiers:

(16) a. $\exists\!\!\!\exists x \varphi \overset{\text{def}}{=} \lambda p \exists x \varphi(p)$
b. $\forall\!\!\!\forall x \varphi \overset{\text{def}}{=} \lambda p \forall x \varphi(p)$

4 *Wh*-questions and the abstract

- We assume that questions, whether embedded or not, are headed by a silent Q morpheme (Baker 1970), which projects an *interrogative nucleus*. The complement of Q is the *abstract*.

(17) interrogative nucleus
[Q abstract]

- The abstract is of type $\langle e^n, T\rangle$: e.g. $\langle e, T\rangle$ for single-*wh* questions, $\langle e, eT\rangle$ for double-*wh*-questions.

- We could naively assume that wh-phrases like *who* are identity functions:

(18) e.g. $[\![\text{who}]\!]_g$ in subject position = $\lambda P_{et}\lambda x_e.P(x)$

- This differs from the treatment in Theiler (2014), where wh-phrases are treated as inquisitive existentials.

- But this will not work when we need to pass the abstract across sentence boundaries:

(19) Whom do you want Mary to invite?

- Here, *want* expects a proposition, so *whom* must leave a trace behind or be interpreted in situ at LF.

- This process can violate islands, so an in-situ based account is preferable (cf. Reinhart 1997):

(20) a. Who thinks that who walks?
b. Who will be offended if we invite whom?

- So we assume instead, following Baker (1970), that *who* carries an index, and that the Q morpheme binds such indices or triggers lambda abstraction below it:

(21) a. Who walks? $\rightsquigarrow$ [Q [1 [who$_1$ walks]]]
b. Who loves whom? $\rightsquigarrow$ [Q [1 [2 [who$_1$ loves whom$_2$]]]]
c. Who thinks that who walks? $\rightsquigarrow$ [Q [1 [2 [who$_1$ thinks [that who$_2$ walks]]]]]

- Sometimes the abstract will be noninquisitive:

(22) a. $[\![$[1 [who$_1$ walks]]$]\!] = \lambda x_1.\widehat{\text{walk}}(x_1)$
b. $[\![$[1 [2 [who$_1$ loves whom$_2$]]]$]\!] = \lambda x_1 \lambda x_2.\widehat{\text{love}}(x_2)(x_1)$

- Sometimes it will be inquisitive:

(23) Who walks or talks?

a. [Q [1 [who$_1$ [walks or talks]]]]

b. $[\![$[1 [who$_1$ [walks or talks]]]]$]\!] = \lambda x_1.\widehat{\text{walk}}(x_1) \vee \widehat{\text{talk}}(x_1)$

- The basic meaning InqB assigns to (21a) and (21b) captures their mention-some reading:

(24) a. $?\exists x.\widehat{\text{walk}}(x)$

b. $?\exists x \exists y.\widehat{\text{love}}(y)(x)$

- For example, (24a) has the following alternatives:
that John walks, that Mary walks, …, that nobody walks

- It would be a mistake to treat inquisitive abstracts in the same way, however:

(25) $?\exists x.\widehat{\text{walk}}(x) \vee \widehat{\text{talk}}(x)$

- This has the following alternatives: *that John walks, that John talks, that Mary walks, that Mary talks, …,* and *that nobody walks or talks.*

- A better translation uses noninquisitive closure:

(26) $?\exists x.!(\widehat{\text{walk}}(x) \vee \widehat{\text{talk}}(x))$

- This has the alternatives *that John walks or talks, that Mary walks or talks, …, that nobody walks or talks.*

- What is responsible for the introduction of noninquisitive closure?

- Compositionally, we seem to have two options: ! is introduced by Q, or by the *wh*-phrases.

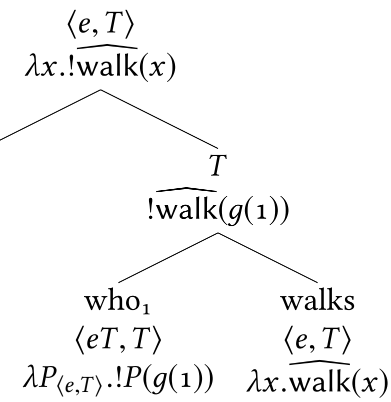
- In non-*wh* questions, Q often does not seem to introduce !

(27) Would you like coffee↑, or tea↓?
≠ Is it the case that you would like either coffee or tea?

- So we assume that it is the *wh*-phrases that are responsible for the introduction of !.

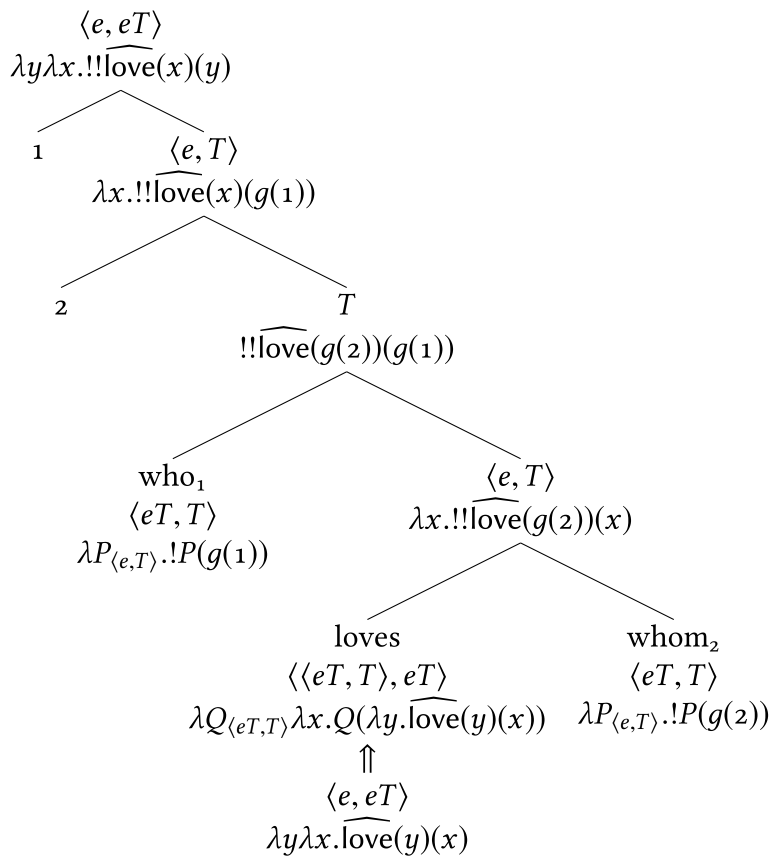
(28) $[\![\text{who}_i]\!]_g = \lambda P_{\langle e,T\rangle} !P(g(i))$ type $\langle eT, T\rangle$

(29)



- In nonsubject position, we resolve type mismatches by type-shifting (Hendriks 1993).

(30)



5 The Q operator

- The Q operator maps abstracts to inquisitive propositions.
- As is well known, there are several relevant candidate propositions:

(31) John knows who is tall.

a. John knows of some x that x is tall. *mention-some*

b. John knows of every tall x that x is tall. *weakly exhaustive*
c. John knows of every x whether x is tall. *strongly exhaustive*

- Groenendijk & Stokhof (1984) take (31c) as basic, which makes it hard to model (31a) and (31b) (Heim 1994, Beck & Rullmann 1999).
- Theiler (2014) takes (31a) as basic, and models (31c) through an additional exhaustification operation.
- We assume that exhaustification optionally takes place within the interrogative nucleus; the precise "flavor" of exhaustivity in embedded questions is determined by an embedding operator that does not play a role in root questions (Theiler, Roelofsen & Aloni 2016).
- We base the meaning of Q on the inquisitive existential $\exists\!\!\!\exists$ and on the operator ?. (This is a simplification. For certain purposes involving non-*wh* questions, it would be more accurate to use $\langle ? \rangle$, which leaves inquisitive meanings alone, and applies ? only to noninquisitive meanings.)

(32) $[\![\text{Q}^n]\!]_g = \lambda P_{\langle e^n,T\rangle}.?\exists\!\!\!\exists x^n.P(x^n)$ type $\langle e^nT,T\rangle$

- Some special cases:

(33) a. $[\![\text{Q}^0]\!]_g$ (for non-*wh* questions) $= \lambda P_T.?P$ type $\langle T,T\rangle$
b. $[\![\text{Q}^1]\!]_g$ (for single-*wh* questions) $= \lambda P_{\langle e,T\rangle}.?\exists\!\!\!\exists x.P(x)$ type $\langle eT,T\rangle$
c. $[\![\text{Q}^2]\!]_g$ (for double-*wh* questions) $= \lambda R_{\langle e,eT\rangle}.?\exists\!\!\!\exists x\exists\!\!\!\exists y.R(x)(y)$ type $\langle\langle e,eT\rangle,T\rangle$

- A second version of the operator has exhaustivity built in:

(34) $[\![\text{Q}^n_{+exh}]\!]_g = \lambda R_{\langle e^n,T\rangle}.\lambda p.\forall q \subseteq p.(\lambda x^n.R(x^n)(q) = \lambda x^n.R(x^n)(p))$ type $\langle e^nT,T\rangle$

- Some special cases:

(35) a. $[\![\text{Q}^0_{+exh}]\!]_g$ (for non-*wh* questions)
$= \lambda P_T.?P = \lambda P_T.P \vee\!\!\!\vee \neg P$ type $\langle T,T\rangle$
b. $[\![\text{Q}^1_{+exh}]\!]_g$ (for single-*wh* questions)
$= \lambda P_{\langle e,T\rangle}.\lambda p.\forall q \subseteq p.(\lambda x.P(x)(q) = \lambda x.P(x)(p))$ type $\langle eT,T\rangle$
c. $[\![\text{Q}^2_{+exh}]\!]_g$ (for double-*wh*)
$= \lambda R_{\langle e,eT\rangle}.\lambda p.\forall q \subseteq p.(\lambda y\lambda x.R(y)(x)(q) = \lambda y\lambda x.R(y)(x)(p))$ type $\langle\langle e,eT\rangle,T\rangle$

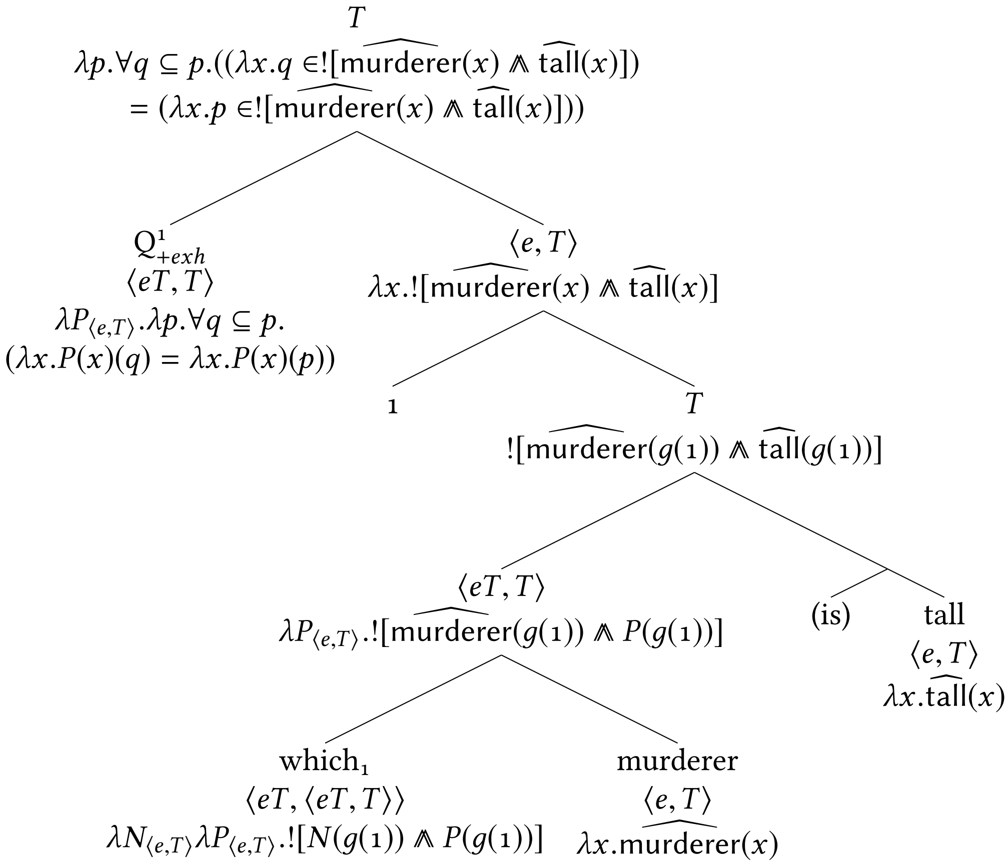
6 *Which*-questions

- Following Groenendijk & Stokhof (1984), we assume that *which*-questions interpret their restrictor noun *in situ.*

(36) $[\![\text{which}_i]\!]_g = \lambda N_{\langle e,T\rangle}\lambda P_{\langle e,T\rangle}.![N(g(i)) \wedge\!\!\!\wedge P(g(i))]$ type $\langle eT,\langle eT,T\rangle\rangle$

- As for *who*, in nonsubject position we resolve type mismatches by type-shifters on the verb.

(37)



- This gives us access to the kind of object we need in order to compute a *de dicto* reading.

7 The presuppositions of *wh*-questions

- Following Groenendijk & Stokhof (1984) we have given what amounts to a symmetric account. This, however, can't be the whole story:

(38) Adapted from Higginbotham (1996):

a. Which man is a bachelor?
b. #Which bachelor is a man?

- Rullmann & Beck (1998) capture the contrast between these questions in terms of the presuppositions of the *which*-phrase. We will implement a version of their account in a presuppositional inquisitive semantics.

- In InqB, the semantic content of a sentence is a set of possibilities. Each possibility, in turn, is a set of possible worlds.

- We can think of each possibility as representing a potential update of the common ground.

- We now propose to model possibilities as having two components, one presuppositional and one at-issue.
- The presuppositional component represents the precondition of the potential update, the at-issue component determines the effect of the update in case the precondition is met (for reasons of space and time a detailed discussion of the discourse pragmatics that we assume is suppressed here).
- For a possibility s to support *Which bachelor is a man?* there should be some individual d such that:
  - the presuppositional component of s entails that d is a bachelor, and
  - the at-issue component of s entails that d is a man.
- Given the background assumption that all bachelors are men (which can be encoded using a meaning postulate), the presuppositional support requirement guarantees that the at-issue support requirement will be satisfied. In other words, the at-issue support requirement is vacuous, in light of the presuppositional requirement. This explains, in short, why the question is odd.
- Making this more precise calls for a presuppositional extension of inquisitive semantics.

8 Presuppositional typed inquisitive semantics

8.1 Basic semantic notions

Possibilities

- A **possibility** s is pair $\langle \pi_s, \alpha_s \rangle$, where π_s and α_s are both sets of worlds, and $\pi_s \supseteq \alpha_s$.
- We call π_s the **presupposition** of s, and α_s the **at-issue information** of s.
  - If $\pi_s = W$, then the presupposition of s is trivial.
  - If $\alpha_s = \pi_s$, then the at-issue information of s is trivial.
- Given that $\alpha_s \subseteq \pi_s$, s can always be represented as a three-valued total function from worlds into $\langle 1, 0, \# \rangle$, but we focus on the pair-representation.

Ordering possibilities

- $s \sqsubseteq t$ iff $\pi_s \subseteq \pi_t$ and $\alpha_s \subseteq \alpha_t$
- The inconsistent possibility is $\langle \emptyset, \emptyset \rangle$. It is the strongest of all possibilities.
- A possibility s is at-issue inconsistent iff $\alpha_s = \emptyset$.

Abbreviations

- $s^\top = \langle \pi_s, \pi_s \rangle$ trivializes the at-issue information of s
- $s^\perp = \langle \pi_s, \emptyset \rangle$ makes the at-issue information of s inconsistent

Propositions

- An inquisitive proposition is a set of possibilities $P \in D_{\langle st, \langle st, t \rangle \rangle}$ such that:
  - P is non-empty;
  - If $s \in P$ and $t \sqsubseteq s$ then $t \in P$ as well.

8.2 Type theory

- We use relational type theory, TT_2, which has the same basic types as TY_2, but in addition to functional types it also has relational (cartesian product) types.
  - Basic types: e, s, t
  - Functional types: if α and β are types, then $\langle \alpha, \beta \rangle$ is as well
  - Relational types: if α and β are types, then $\alpha \times \beta$ is as well
- The type of inquisitive propositions: $T \coloneqq \langle st \times st, t \rangle$
- Abbreviations in the object language:
  - $\pi_s \coloneqq \pi_1(s)$
  - $\alpha_s \coloneqq \pi_2(s)$
  - $s^\top = \langle \pi_s, \pi_s \rangle$
  - $s^\perp = \langle \pi_s, \emptyset \rangle$
  - $s^\alpha = \langle \alpha_s, \alpha_s \rangle$
  - $s \sqsubseteq t \coloneqq \alpha_s \subseteq \alpha_t \wedge \pi_s \subseteq \pi_t$
  - $\mathsf{true}(P, w) \coloneqq P(\langle \{w\}, \{w\} \rangle)$
  - $\mathsf{presup}(P) \coloneqq \lambda s. P(s^\perp)$
  - $A(P) \coloneqq \lambda s. P(s^\alpha)$
  - $|P| \coloneqq \lambda w. \mathsf{true}(P, w)$
  - $s[P] \coloneqq \langle \pi_s \cap |P|, \alpha_s \cap |P| \rangle$
  - $\mathsf{Inq}(P) \coloneqq \forall s[Ps \rightarrow \alpha_s \subseteq \pi_s] \wedge \forall s \forall t[t \sqsubseteq s \wedge Ps \rightarrow Pt]$
- Inquisitive connectives and transplication in the object language:
  - $\bot \coloneqq \lambda s.(\alpha_s = \emptyset)$
  - $P \Cap Q \coloneqq \lambda s. P(s) \wedge Q(s[P])$
  - $P \twoheadrightarrow Q \coloneqq \lambda s.(P(s^\perp) \wedge \forall t \sqsubseteq s.(P(t) \rightarrow Q(t[P]))$

- $\neg P := P \twoheadrightarrow \bot$
- $P \mathbin{\mathbb{V}} Q := \lambda s.P(s) \vee Q(s)$ [existential projection]
- $P \mathbin{\mathbb{V}_{\text{lr}}} Q := \lambda s.P(s) \vee Q(s[\neg P])$ [left to right filtering]
- $P \mathbin{\mathbb{V}_{\text{sym}}} Q := \lambda s.P(s[\neg Q]) \vee Q(s[\neg P])$ [symmetric filtering]
- $P_Q := \lambda s.Ps \wedge Q(s^\top)$ [transplication]

- Projection operators:
  - $?P := P \mathbin{\mathbb{V}} \neg P$
  - $!P := \lambda s.\exists S.(\forall t \in S : t \models \varphi \wedge \bigsqcup S = s)$ where $\bigsqcup S = \langle \bigcup_{s \in S} s_\pi, \bigcup_{s \in S} s_\alpha \rangle$

- Conditional inquisitive projection:
  - $\langle ? \rangle := \lambda P.\lambda s.P(s) \vee (P = !P \wedge \neg P(s))$

  This gives:
  - If P is non-inquisitive then $\langle ? \rangle P = ?P$
  - If P is inquisitive then $\langle ? \rangle P = P$

- Inquisitive universal and existential quantifiers:
  - $\mathbb{A}x.P := \lambda s.\forall x.P(s)$
  - $\mathbb{E}x.P := \lambda s.\exists x.P(s)$

- Abbreviation for entailment in the object language:
  - $P \models Q \quad := \quad \forall s.P(s) \rightarrow Q(s)$

- Exhaustivity operator, needed for *which*-questions:
  - $\mathsf{exh}(x, R_{\langle e,T \rangle}) \quad := \quad R(x) \mathbin{\mathbb{A}} \lambda s.\forall y(Rx \not\models Ry \rightarrow \neg(Ry)(s))$

9 Fragment

9.1 Predicates

- Non-presuppositional predicate:
  - $\mathbf{walk}' = \lambda x \lambda s.\alpha_s \subseteq \pi_s \wedge \alpha_s \subseteq W(x)$

- For p_0 a state (type $\langle s, t \rangle$), we write $\widehat{p_0}$ for the inquisitive proposition:
  - $\lambda s.\alpha_s \subseteq \pi_s \wedge \alpha_s \subseteq p_0$

  Similarly, for p_n of type $\langle e^n, st \rangle$, we write $\widehat{p_n}$ for:
  - $\lambda \vec{x} \lambda s.\alpha_s \subseteq \pi_s \wedge \alpha_s \subseteq p_n(\vec{x})$

- So now we can write: **walk**′ = $\widehat{W}$
- Presuppositional predicate:

(39) $\textbf{bachelor}' = \lambda x.\widehat{\mathsf{unmarried}}(x)_{\widehat{\mathsf{male}}(x)}$
$= \lambda x.\lambda s.\widehat{\mathsf{unmarried}}(x)(s) \wedge \widehat{\mathsf{male}}(x)(s^{\top})$
$= \lambda x.\lambda s.\alpha_s \subseteq \pi_s \wedge \alpha_s \subseteq \mathsf{unmarried}(x) \wedge \pi_s \subseteq \mathsf{male}(x)$

9.2 First steps towards presuppositional questions

- Interrogative operator:

(40) $\mathbf{Q}'_n = \lambda P_{\langle e^n, T\rangle}.(\langle ? \rangle \exists \vec{x}.P(\vec{x}))_{!\langle ? \rangle \exists \vec{x}.P(\vec{x})}$

- This presupposes that at least one of the alternatives holds.
- *Who*:

(41) $\textbf{who}'_i = \lambda P.!P(x_i)$

- Basic entry for *which*:

(42) $\textbf{which}'_i = \lambda N.\lambda P.!P(x_i)_{N(x_i)}$

Refinement to capture that the extension of N is presupposed to be fixed:

(43) $\textbf{which}'_i = \lambda N.\lambda P.!P(x_i)_{N(x_i);\, \forall x?N(x)}$

Refinement to capture the fact that *which*-questions only generate strongly exhaustive readings:

(44) $\textbf{which}'_i = \lambda N.\lambda P.[\mathsf{exh}(x_i, \lambda x.!(N(x) \wedge P(x))]_{N(x_i);\, \forall x?N(x)}$

With a singular noun as a complement, this amounts to:

(45) $\textbf{which}'_i = \lambda N.\lambda P.[!(N(x_i) \wedge P(x_i)) \wedge$
$\lambda s.\forall y \neq x_i.(\neg!(N(y) \wedge P(y)))(s)]_{N(x_i);\, \forall x?N(x)}$

This captures:

  - Together with the Q operator, which triggers the **presupposition** that at least one of the alternatives holds, we predict a uniqueness presupposition for singular *which*-questions.

- The **resolution conditions** require a possibility s such that for some set of individuals x_i, s presupposes that x_i are N, and it asserts that x_i are the only N who are P.

  This improves on Rullmann & Beck (1998). There it is predicted that it is sufficient to establish of some x_i that they are N who are P (not that they are the only ones).

- Symmetry example, singular predicates:

(46) Which man is a bachelor?

(47) [Q 1 [which$_1$ man is a bachelor]]

(48) $$\left[\exists x[\mathsf{exh}(x, \lambda y(\widehat{\mathsf{male}}(y) \mathbin{\wedge\!\!\!\wedge} \mathsf{un}\widehat{\mathsf{married}}(y)))]_{\widehat{\mathsf{male}}(x)}\right]_{!\exists x \ldots}$$

For a possibility (potential update) s to support the sentence:

- the presuppositional component of s entails that there is exactly one (man who is a) bachelor
- Of some specific individual d, the presuppositional component of s entails that d is a man, and
- the at-issue component of s entails that d is the unique (man who is a) bachelor.

- The other symmetry example, still singular predicates:

(49) Which bachelor is a man?

(50) [Q 1 [which$_1$ bachelor is a man]]

(51) $$\left[\exists x[\mathsf{exh}(x, \lambda y.\mathsf{un}\widehat{\mathsf{married}}(y)_{\widehat{\mathsf{male}}(y)})]_{\mathsf{un}\widehat{\mathsf{married}}(x);\, \widehat{\mathsf{male}}(x)}\right]_{!\exists x \ldots}$$

For a possibility (potential update) s to support the sentence:

- the presuppositional component of s entails that there is exactly one man who is a bachelor
- Of some specific individual d, the presuppositional component of s entails that d is a bachelor, and
- the at-issue component of s entails that d is the unique (man who is a) bachelor.

The presuppositional support requirements guarantee that the at-issue support requirement will be satisfied. In other words, the at-issue support requirement is vacuous, in light of the presuppositional requirements. Call this a **Strawson tautology**. This explains why the question is odd.

- A sentence φ is a **Strawson tautology** iff for any state s: $s \models \varphi \Leftrightarrow s^{\top} \models \varphi$

10 Conclusion

- Typed inquisitive semantics provides compositional derivations
- By reusing the abstract as in Groenendijk & Stokhof (1984), we can interpret short answers
- By assuming that *which*-questions interpret their noun in situ, we account for *de dicto* readings
- Presuppositional inquisitive semantics allows us to capture presuppositions of *which*-questions and restrictor-nucleus asymmetries
- To do: multiple *which*-questions and much more!

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