Composing questions: A hybrid categorial approach

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Roadmap

1. Why pursing a categorial approach?
2. Problems with traditional categorial approaches
3. Proposal: A hybrid categorial approach
4. Applications

1. Why pursing a categorial approach?

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What does a question denote?

Categorial approaches:	λ-abstracts
Hamblin Semantics:	sets of propositions (sets of possible answers)
Karttunen Semantics:	sets of propositions (sets of true answers)
Partition Semantics:	partitions of worlds

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Short answers in discourse: bare nominal or covertly clausal?

(1) Who did John see?

a. John saw Mary. (full answer)

b. Mary. (short answer)

- If it is bare nominal, it should be derivable from a question denotation.
- If it is covertly clausal, it denotes a proposition and is derived by ellipsis.

Why pursing a categorial approach?

Categorial approach (Hausser & Zaefferer 1979, Hausser 1983, a.o)

A question denotes a λ-abstract. Short answers are possible arguments of a question.

(2) $[\![\text{who came}]\!] = \lambda x[\mathit{hmn}(x).\mathit{came}(x)]$

$[\![\text{who came}]\!]([\![\text{John}]\!]) = \mathit{came}(j)$

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A question denotes a set of propositions, each of which is a possible answer of this question. Short answers are covertly clausal and are derived by ellipsis.

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But, there are more independent reasons for pursuing a categorial approach.

1: Caponigro's generalization on free relatives and questions.

Free relatives (FRs)

When used as an FR, a *wh*-construction refers to a nominal short answer.

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If a language uses the *wh*-strategy to form both questions and FRs, the *wh*-words found in FRs are always a subset of those found in questions. (Caponigro 2003)

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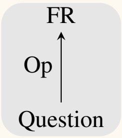

(Op is partial)

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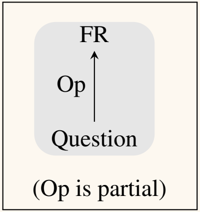
- ☞ *Wh*-FRs are formed out of *wh*-questions.
- ☞ Short answers shall be semantically derivable from the root denotation of a question.



Why pursing a categorial approach?

2: Quantificational variability effects

(5) For the most part, John knows which students came.
$\approx$ 'For most of the students who did come, John knows that they came.'

2: Quantificational variability effects

- In most cases, the domain restriction of a matrix quantificational adverb can be formed by atomic **short** answers or **propositional** answers. (Lahiri 1991, 2002; Cremers 2016, a.o.)

(5) For the most part, John knows which students came.
$\approx$ 'For most of the students who did come, John knows that they came.'

(Context: *Among the consider four students, abc came but d didn't.*)

a. ✓ MOST x [$x \in \{a, b, c\}$] [J knows that x came]
b. ✓ MOST p [$p \in \{\hat{}\mathsf{came}(a), \hat{}\mathsf{came}(b), \hat{}\mathsf{came}(c)\}$] [J knows p]

2: Quantificational variability effects (cont.)

- But, if the embedded questions has a non-divisive predicate, the domain restriction must be recovered based on a **short answer** (Schwarz 1994).

(6) For the most part, John knows [$_Q$ who formed the committee].
$\approx$ 'For most of the committee members, John knows that they were in the committee.'

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≈ 'For most of the committee members, John knows that they were in the committee.'

(Context: *The committee was formed by abc*.)

a. ✓ $\textsc{Most}\ x\ [x \in \textsc{At}(a \oplus b \oplus c)]$ [J knows that x was in the committee]
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☞ Short answers must be derivable from the embedded question.

Why pursing a categorial approach?

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- William (2000) salvages the proposition-based account by interpreting the embedded question with a **sub-divisive reading**,

(7) John knows which professors formed the committee

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a. $[\![\text{which}]\!] = \lambda A_{\langle e,t\rangle} \lambda P_{\langle e,t\rangle} \lambda p_{\langle s,t\rangle} . \exists x \in A[p = \lambda w. \exists y \in A[y \geq x \wedge P_w(y)]]$

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b. $[\![\text{which profs}_{@}\text{ f.t.b.q.}]\!]$
$= \lambda p.\exists x[*\mathit{prof}_{@}(x) \wedge p = \lambda w.\exists y[*\mathit{prof}_{@}(y) \wedge y \geq x \wedge \mathit{f.t.b.q.}_w(y)]]$
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- But, this sub-divisive reading is unavailable. Compare:

(8) a. Who is part of the professors who formed the committee, for example?
b. Which professors formed the committee, # for example?

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Among the canonical approaches of question semantics, only categorial approaches can derive short answers from question roots semantically.

A full comparison of approaches to question semantics

	Categorial	Karttunen	Hamblin	Partition
Nominal short answers	✓	✗	✗	(✓)

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Nominal short answers	✓	✗	✗	(✓)
Wh-items as ∃-indefinites	✗	✓	✗	✗
Conjunctions of questions	✗	✓	✓	✓
Variations of exhaustivity	✓	✓	✓	✗

2. Traditional categorial approaches and their problems

Traditional categorial approaches

Assumptions of traditional categorial approaches:

- A question denotes a λ-abstract.

(9) a. $[\![\text{who came}]\!] = \lambda x[\mathit{hmn}(x).\mathit{came}(x)]$
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- A *wh*-determiner denotes a λ-operator.

(10) a. $[\![\text{who}]\!] = \lambda P \lambda x[\mathit{hmn}(x).P(x)]$
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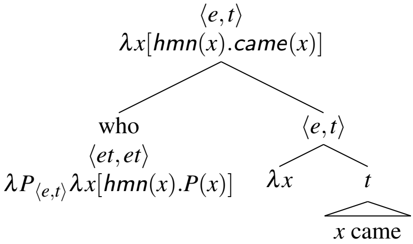
- Composing a single-*wh* question:

(11)



Problems of traditional categorial approaches

1. **Existential semantics of *wh*-words**

- Defining the *wh*-determiner as a **λ-operator**, traditional categorial approaches cannot capture the existential semantics of *wh*-words.

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- Cross-linguistically, *wh*-words behave like **∃-indefinites** in non-interrogatives.

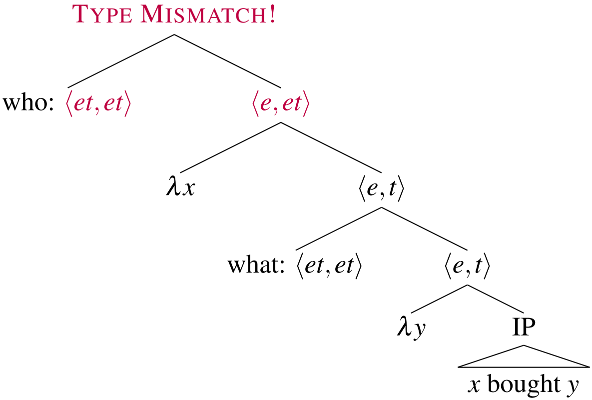
(13) Mandarin

a. Yuehan haoxiang jian-le **shenme-ren**.
John perhaps meet-PERF what-person
'It seems that John met **someone**.'

b. Ruguo Yuehan jian-guo **shenme-ren**, qing gaosu wo.
If John meet-EXP what-person, please tell me.
'If John met **someone**, please tell me.'

2. **Composing the single-pair reading of multi-*wh* suffers type mismatch.**

(14) $[\![\text{who bought what}]\!] = \lambda x \lambda y[\mathit{hmn}(x) \wedge \mathit{thing}(y).\mathit{came}(x)]$



3. **Coordinations of questions**

- Conjunction and disjunction are standardly defined as **meet** and **join**. (Partee & Rooth 1983, Groenendijk & Stokhof 1989). Coordinated expressions must be of **the same conjoinable type**.

$$A' \sqcap B' = \begin{cases} A' \wedge B' & \text{if } A'B' \text{ are of type } t \\ \lambda x[A'(x) \sqcap B'(x)] & \text{if } A'B' \text{ are of some other conjoinable type} \\ \text{undefined} & \text{otherwise} \end{cases}$$

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d. *John and student — $\#\text{LIFT}(\textit{John})_{\langle et,t\rangle} \sqcap \textit{student}_{\langle e,t\rangle}$

$\#\textit{John}_e \sqcap \textit{student}_{\langle e,t\rangle}$

3. **Coordinations of questions** (cont.)

- But, categorial approaches assign different questions with different semantic types. Hence, they have difficulties in getting coordinations of questions.

(16) a. John knows [[who came]$_{\langle e,t \rangle}$ **and** [who bought what]$_{\langle e,et \rangle}$]

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- Questions can also be coordinated with declaratives:

(17) John knows [[who came] and [that Mary bought Coke]].

Problems of traditional categorial approaches

3. **Coordinations of questions** (cont.)

- Even if the coordinated questions are of the same conjoinable type, categorial approaches do not predict the correct prediction.

(18) John knows [$_{\langle e,t\rangle}$ who voted for Andy] and [$_{\langle e,t\rangle}$ who voted for Billy].
(Predicted reading: #'John knows who voted for both Andy and Billy'.)

(19) $[\![$who voted for Andy and who voted for Billy$]\!]$
$= [\![$who voted for Andy$]\!] \sqcap [\![$who voted for Billy$]\!]$
$= \lambda x[\mathit{hmn}(x).\mathit{vote\text{-}for}(x,a)] \sqcap \lambda x[\mathit{hmn}(x).\mathit{vote\text{-}for}(x,b)]$
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- Inquisitive Semantics overcomes this problem. (Ciardelli & Roelofsen 2015, Ciardelli et al. 2017)

Interim summary

- We have to pursue a categorial approach, so as to capture:
  1. Quantificational variability effects
  2. Caponigro's generalization
  3. Other predicative embedded *wh*-constructions:
     - Question-Answer clauses in ASL
     - Mandarin *wh*-conditionals
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☞ **Goal**: To revive the categorial approach and overcome its problems.

3. Proposal: A hybrid categorial approach

Proposal: Questions denote topical properties

Topical properties are λ-abstracts ranging over propositions. A topical property maps a short answer to a propositional answer.

(20) Which boy came?

a. $\mathbf{P} = \lambda x[\mathit{boy}_{@}(x) = 1.\hat{}\mathit{came}(x)]$

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Dom($\mathbf{P}$)	$\mathit{boy}_{@}$	the set of possible SAa
$\{\mathbf{P}(\alpha) : \alpha \in \text{Dom}(\mathbf{P})\}$	$\{\hat{}\mathit{came}(x) : x \in \mathit{boy}_{@}\}$	Hamblin set

Proposal: Composing topical properties

1. The property domain:

(21) Which boy came?

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c. $\text{B}\textsc{e}([\![\text{which boy}_{@}]\!]) = \mathit{boy}_{@}$

BE converts an $\exists$-quantifier $\mathscr{P}$ to its live-on set (viz. its quantification domain).

(22) $\text{B}\textsc{e}(\mathscr{P}) = \lambda x[\mathscr{P}(\lambda y.y = x)]$

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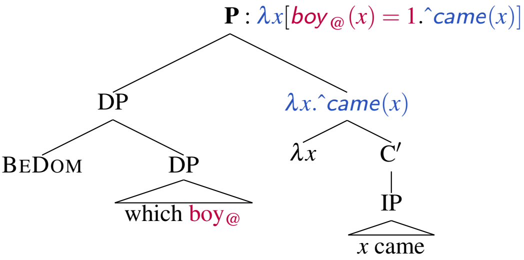

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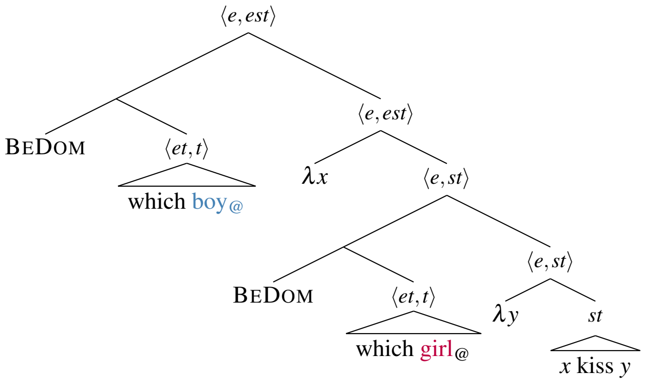

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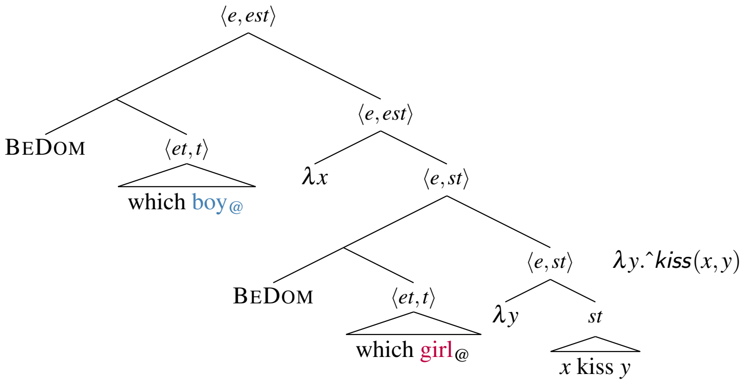

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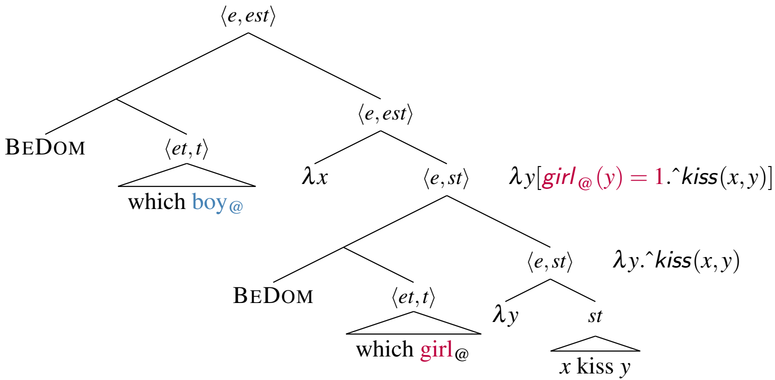

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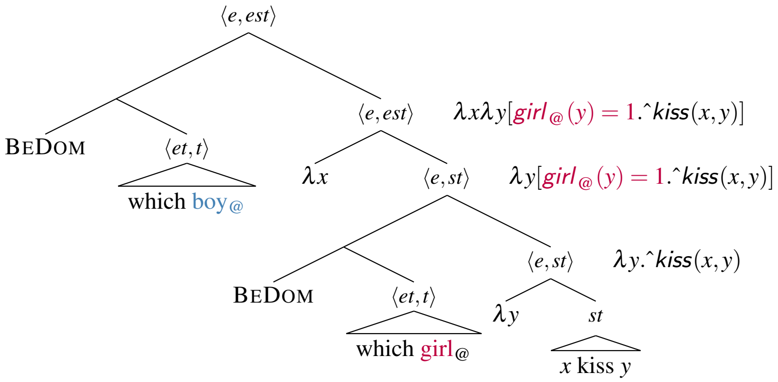

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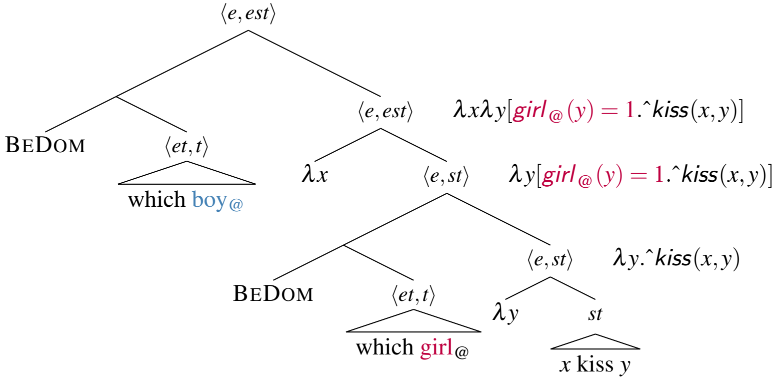

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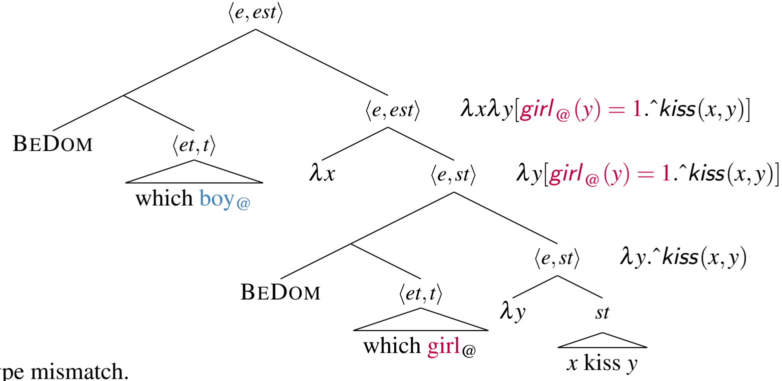
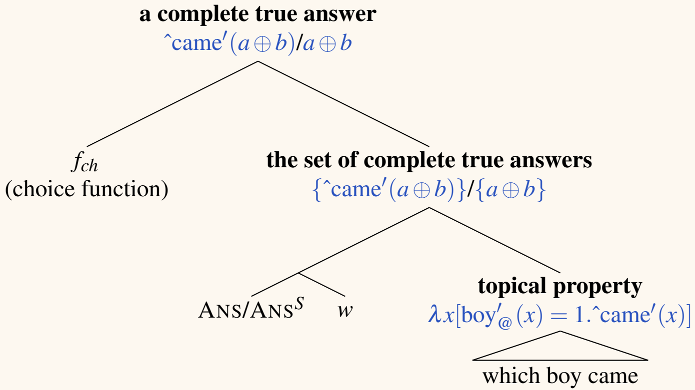


No type mismatch.

▸ 
a complete true answer
$^\wedge\text{came}'(a \oplus b) / a \oplus b$
f_{ch}
(choice function)
the set of complete true answers
$\{^\wedge\text{came}'(a \oplus b)\} / \{a \oplus b\}$
ANS/ANS^S
w
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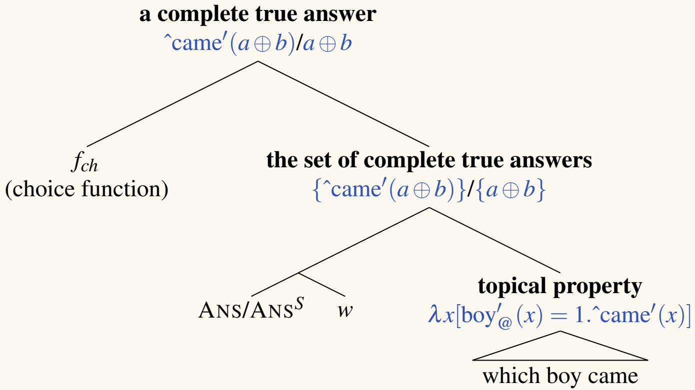
- 

- **Note:** This tree is to demonstrate the derivation of answers, not a LF structure. f_{ch} and ANS are not necessarily syntactically present. They can be purely semantically active, or are lexically encoded within a question-embedding predicate/determiner.

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For propositional answers:

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Proposal: Interim summary

- ✓ Existential semantics of *wh*-words
- ✓ Type-mismatch of composing multi-*wh* questions
- ✓ Getting short answers

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- ?? Getting coordinations of questions

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Proposed semantics of conjunctions

(26) The conjunction *A and B* is semantically ambiguous:

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$$[\![A \text{ and } B]\!] = A' \bar{\wedge} B' = \lambda\alpha[\alpha(A') \wedge \alpha(B')]$$
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- Question coordinations are generalized quantifiers.

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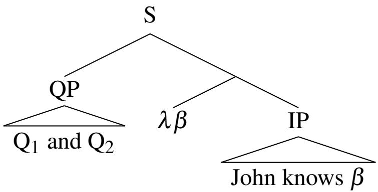

a. $[\![\text{IP}]\!] = \mathit{know}(j, \beta)$

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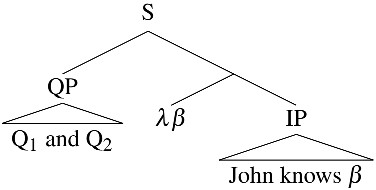

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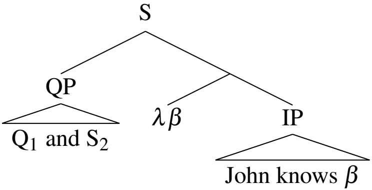

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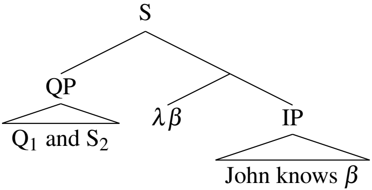

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$= (\lambda\beta.\mathit{know}(j,\beta))(Q_1') \wedge (\lambda\beta.\mathit{know}(j,\beta))(S_2')$

$= \mathit{know}(j, Q_1') \wedge \mathit{know}(j, S_2')$

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- *Surprise* is non-divisive:

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☞ Conjunctions of questions must scope above *surprise*.

Getting coordinations of questions

Validation 2: [Q_1 or Q_2] > *know*

In (32-a), John needs to know the complete true answer of one of the questions, not just the disjunction of the complete true answers of the two questions.

(32) a. John knows [whether Mary invited *a*] **or** [whether Mary invited *b*].

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Fact	Yes	Yes	Yes
John's belief	?	?	Yes

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b. John knows that Mary invited *a* or *b* (or both). TRUE

A challenging case

- The disjunction of questions seems can freely take scope above or below an **intensional predicate** (e.g., *wonder*, *investigate*). (Gr& S 1989)

(33) Peter wonders [$_{Q1}$whom John loves] or [$_{Q2}$whom Mary loves].

a. Wide scope reading
The speaker knows that Peter wants to know the answer to Q1 or the answer to Q2, but she is unsure to which question this answer is.

b. Narrow scope reading
Peter will be satisfied as long as he gets an answer to Q1 or the answer to Q2, no matter which one.

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a. Wide scope reading
The speaker knows that Peter wants to know the answer to Q1 or the answer to Q2, but she is unsure to which question this answer is.

b. Narrow scope reading
Peter will be satisfied as long as he gets an answer to Q1 or the answer to Q2, no matter which one.

- **Reply**: Decompose *wonder* into *wants to know* (Karttunen 1977, Guerzoni & Sharvit 2007, Uegaki 2015: chap. 2). The seeming narrow scope reading arises if the disjunction of questions scopes in between *want* and *know*.

(34) a. Wide scope reading
[[Q_1 or Q_2] $\lambda\beta$ [Peter wants to know β]]

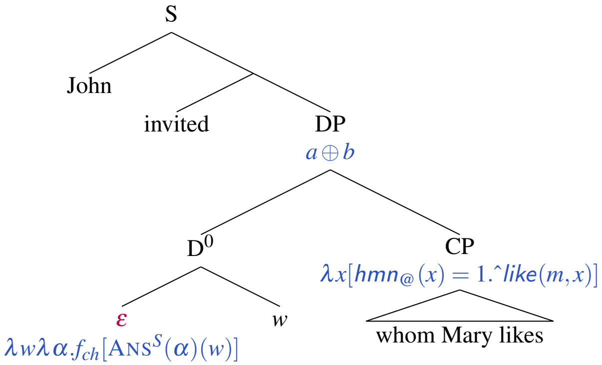
b. Narrow scope reading
[Peter wants [[Q_1 or Q_2] $\lambda\beta$ [to know β]]]

4. Applications

(See more applications in Xiang (2016: chap. 1).)

Application I: Free relatives

(35) John invited [whom Mary likes].
(Context: *Mary only likes Andy and Billy.*)



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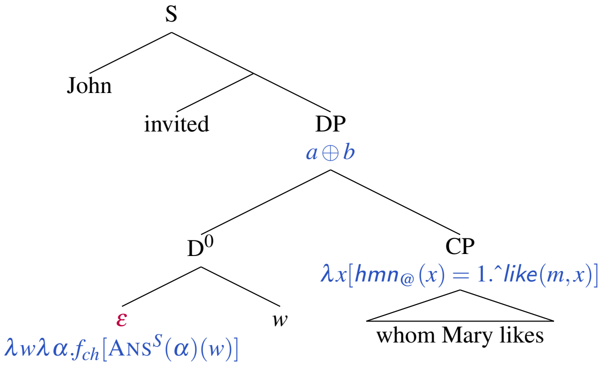

Caponigro's generalization is captured:
wh-FRs are derived from *wh*-questions with the application of an ε-determiner.

Application II: Getting quantificational variability effects

The quantity adverb in an indirect question quantifies over either (i) or (ii):

(i) the set of atomic subparts of some complete true **propositional** answer

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Based on a propositional complete true answer

(36) $[\![\text{John mostly knows Q}]\!]^w = 1$ if and only if
$\exists p \in \textsc{Ans}([\![\text{Q}]\!])(w)[\textsc{Most}\ q[p \subseteq q \wedge q \in \textsc{At}(Q)][\mathsf{know}(j,q)]]$
(For some p such that p is MaxI true propositional answer of Q, John knows most of the atomic possible answers of Q that are entailed by p.)

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Based on a short complete true answer

(37) $[\![\text{John mostly knows Q}]\!]^w = 1$ if and only if
$\exists f_{\text{CH}} \exists x \in \textsc{Ans}^S([\![\text{Q}]\!])(w)[\textsc{Most}\ y[y \in \textsc{At}(x)]$
$[\mathit{know}_w(j, \lambda w'.y \leq f_{\text{CH}}[\textsc{Ans}^S([\![\text{Q}]\!])(w')])]]$
(For some x s.t. x is a MaxI true short answer of Q, most y in $\textsc{at}(x)$ are s.t. John knows that y is a part of some particular MaxI true short answer of Q.)

Example

(38) For the most part, John knows [$_{\text{Q}}$ which professors formed the committee].
(Context: *The committee is formed by three professors abc*)

a. $\text{A}\textsc{ns}^{s}([\![\text{Q}]\!])(w) = \{a \oplus b \oplus c\}$
b. $\text{A}\textsc{t}(a \oplus b \oplus c) = \{a, b, c\}$
c. QV inference:
$\lambda w.\exists f_{ch}[\text{M}\textsc{ost}\ y[y \in \{a,b,c\}][\textsf{know}_w(j, \lambda w'.y \leq f_{ch}[\text{A}\textsc{ns}^{S}([\![\text{Q}]\!])(w')])]]$

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  - The root denotation of a question is a topical property.
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References

This presentation is based on Xiang (2016: chapter 1) "Interpreting questions with non-exhaustive answers", Doctoral Dissertation, Harvard University.

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