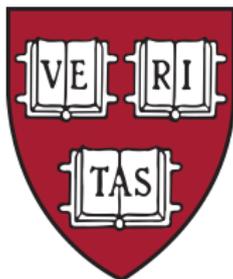


# Composing questions: A hybrid categorial approach

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

# **1. Why pursuing a categorial approach?**

## What does a question denote?

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

- ▶ Categorial approaches were originally motivated to capture the semantic relation between questions and short answers.

## 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 pursuing a categorial approach?

## Categorial approach

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

A question denotes a  $\lambda$ -abstract. Short answers are possible arguments of a question.

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

$$\llbracket \text{who came} \rrbracket(\llbracket \text{John} \rrbracket) = came(j)$$

## Hamblin Semantics

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.

$$(3) \llbracket \text{who came} \rrbracket = \{\hat{came}(x) : hmn(x)\}$$

I don't take a position on the treatment of short answers in discourse.

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

# Why pursuing a categorial approach?

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

### Free relatives (FRs)

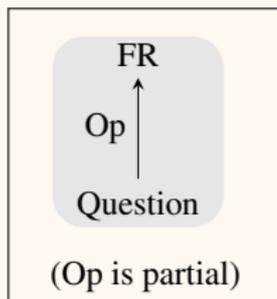
When used as an FR, a *wh*-construction refers to a nominal short answer.

- (4) a. Mary ate [what John bought].  
b. John went to [where he could get help].

### Caponigro's Generalization

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)

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



## 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.  
≈ ‘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  $p$  [ $p \in \{\hat{came}(a), \hat{came}(b), \hat{came}(c)\}$ ] [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**].  
≈ ‘For most of the committee members, John knows that they were in the committee.’  
(Context: *The committee was formed by abc.*)
  - a. ✓ MOST  $x$  [ $x \in AT(a \oplus b \oplus c)$ ] [J knows that  $x$  was in the committee]
  - b. ✗ MOST  $p$  [ $p$  is an atomic true propositional answer of Q] [J knows  $p$ ]

☞ Short answers must be derivable from the embedded question.

## 2: Quantificational variability effects (cont.)

- ▶ William (2000) salvages the proposition-based account by interpreting the embedded question with a **sub-divisive reading**, obtained based on a collective lexicon of the *wh*-determiner.

(7) John knows which professors formed the committee

≈ ‘John knows which prof(s)  $x$  is such that  $x$  is part of the group of profs who formed the committee.’

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

b.  $\llbracket \text{which profs}_{@} \text{ f.t.b.q.} \rrbracket$

$= \lambda p . \exists x [ *prof_{@}(x) \wedge p = \lambda w . \exists y [ *prof_{@}(y) \wedge y \geq x \wedge f.t.b.q._w(y) ] ]$

$= \{ \lambda w . \exists y [ *prof_{@}(y) \wedge y \geq x \wedge f.t.b.q._w(y) ] : x \in *prof_{@} \}$

( $\{x$  is part of a group of profs  $y$  such that  $y$  formed the committee:  $x$  is prof(s) $\}$ )

- ▶ 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**?

# Why pursuing a categorial approach?

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	✓	✗	✗	(✓)
<i>Wh</i> -items as $\exists$ -indefinites	✗	✓	✗	✗
Conjunctions of questions	✗	✓	✓	✓
Variations of exhaustivity	✓	✓	✓	✗

## **2. Traditional categorial approaches and their problems**

## Assumptions of traditional categorial approaches:

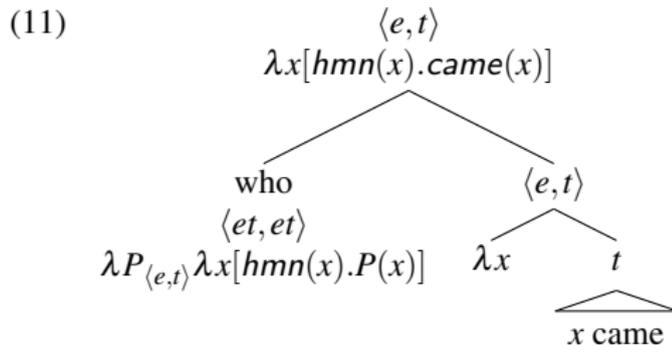
- ▶ A question denotes a  $\lambda$ -abstract.

(9) a.  $\llbracket \text{who came} \rrbracket = \lambda x[\text{hmn}(x).\text{came}(x)]$   
 b.  $\llbracket \text{who bought what} \rrbracket = \lambda x\lambda y[\text{hmn}(x) \wedge \text{thing}(y).\text{came}(x)]$

- ▶ A *wh*-determiner denotes a  $\lambda$ -operator.

(10) a.  $\llbracket \text{who} \rrbracket = \lambda P\lambda x[\text{hmn}(x).P(x)]$   
 b.  $\llbracket \text{what} \rrbracket = \lambda P\lambda x[\text{thing}(x).P(x)]$

- ▶ Composing a single-*wh* question:



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

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

$$(12) \quad \llbracket \text{wh-} \rrbracket = \lambda A \lambda f . \lambda x [A(x) . f(x)]$$

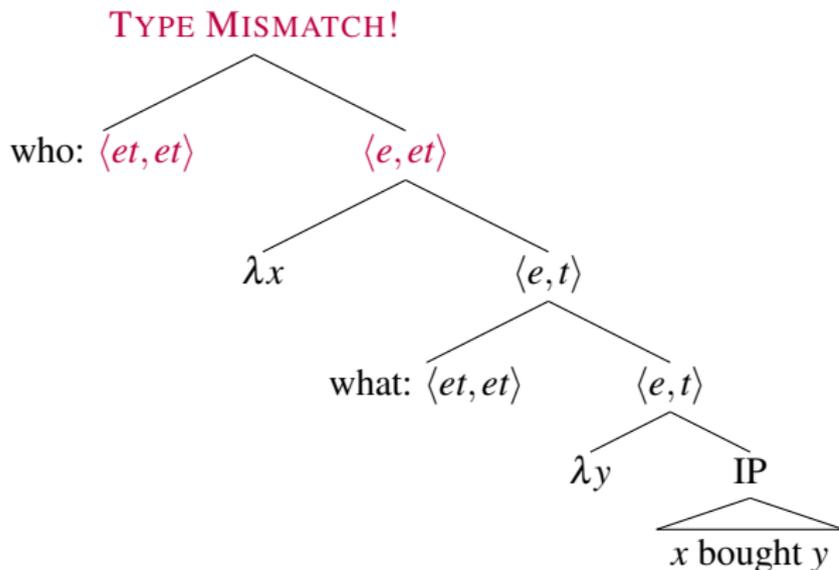
- ▶ Cross-linguistically, *wh*-words behave like  **$\exists$ -indefinites** in non-interrogatives.

(13) Mandarin

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

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



## 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**.

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

### Example

- (15) a. jump and run  
 b. \*jump and look for  
 c. John and every student  
 d. \*John and student
- $$\begin{aligned} & \text{jump}_{\langle e,t \rangle} \sqcap \text{run}_{\langle e,t \rangle} \\ & \# \text{jump}_{\langle e,t \rangle} \sqcap \text{look-for}_{\langle e,et \rangle} \\ & \text{LIFT}(\text{John})_{\langle et,t \rangle} \sqcap \text{every student}_{\langle et,t \rangle} \\ & \# \text{LIFT}(\text{John})_{\langle et,t \rangle} \sqcap \text{student}_{\langle e,t \rangle} \\ & \# \text{John}_e \sqcap \text{student}_{\langle e,t \rangle} \end{aligned}$$

## 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] <sub>$\langle e,t \rangle$</sub>  **and** [who bought what] <sub>$\langle e,et \rangle$</sub> ]

b. John knows [[who came] <sub>$\langle e,t \rangle$</sub>  **or** [who bought what] <sub>$\langle e,et \rangle$</sub> ]

- ▶ Questions can also be coordinated with declaratives:

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

### 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)  $\llbracket$ who voted for Andy and who voted for Billy $\rrbracket$   
=  $\llbracket$ who voted for Andy $\rrbracket \sqcap \llbracket$ who voted for Billy $\rrbracket$   
=  $\lambda x[hmn(x).vote-for(x,a)] \sqcap \lambda x[hmn(x).vote-for(x,b)]$   
=  $\lambda x[hmn(x).vote-for(x,a) \wedge vote-for(x,b)]$

- ▶ Hamblin-Karttunen Semantics are also subject to this problem: conjunctions of questions would be analyzed as the intersection of two proposition sets.
- ▶ Inquisitive Semantics overcomes this problem. (Ciardelli & Roelofsen 2015, Ciardelli et al. 2017)

- ▶ 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
      - ▶ ...
  - ▶ But, traditional categorial approaches have problems:
    - ① Cannot capture the existential semantics of *wh*-words
    - ② Suffers type-mismatch in composing multi-*wh* questions
    - ③ Cannot get coordinations of questions
- 👉 **Goal:** To revive the categorial approach and overcome its problems.

### **3. Proposal: A hybrid categorial approach**

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

(20) Which boy came?

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

b.  $\mathbf{P}(j) = \hat{\text{came}}(j)$

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

## 1. The property domain:

(21) Which **boy** came?

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

b.  $\llbracket \text{which } \mathit{boy}_@ \rrbracket = \lambda f_{\langle e,t \rangle}. \exists x \in \mathit{boy}_@ [f(x)]$

c.  $\mathbf{BE}(\llbracket \text{which } \mathit{boy}_@ \rrbracket) = \mathit{boy}_@$

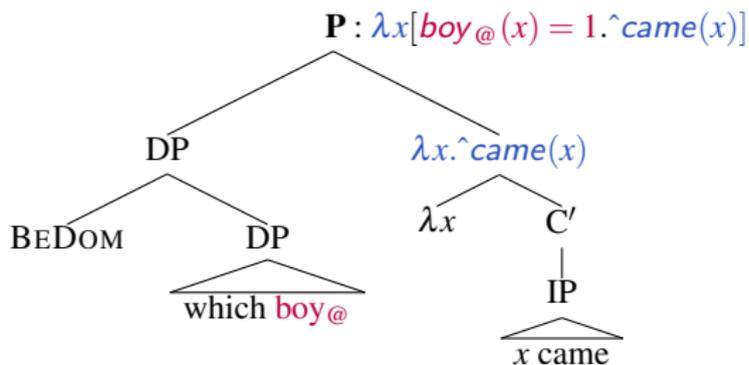
BE converts an  $\exists$ -quantifier  $\mathcal{P}$  to its live-on set (viz. its quantification domain).

(22)  $\mathbf{BE}(\mathcal{P}) = \lambda x[\mathcal{P}(\lambda y.y = x)]$

## 2. Incorporate $\text{BE}(\mathcal{P})$ into $\mathbf{P}$ :

**BEDOM converts a *wh*-item (an  $\exists$ -quantifier) into a domain restrictor**

$\text{BEDOM}(\mathcal{P}) = \lambda \theta_{\tau}. \lambda P_{\tau} [[\text{Dom}(P) = \text{Dom}(\theta) \cap \text{BE}(\mathcal{P})] \wedge \forall \alpha \in \text{Dom}(P)[P(\alpha) = \theta(\alpha)]]$   
(For any function  $\theta$ , restrict the domain of  $\theta$  with  $\text{BE}(\mathcal{P})$ .)



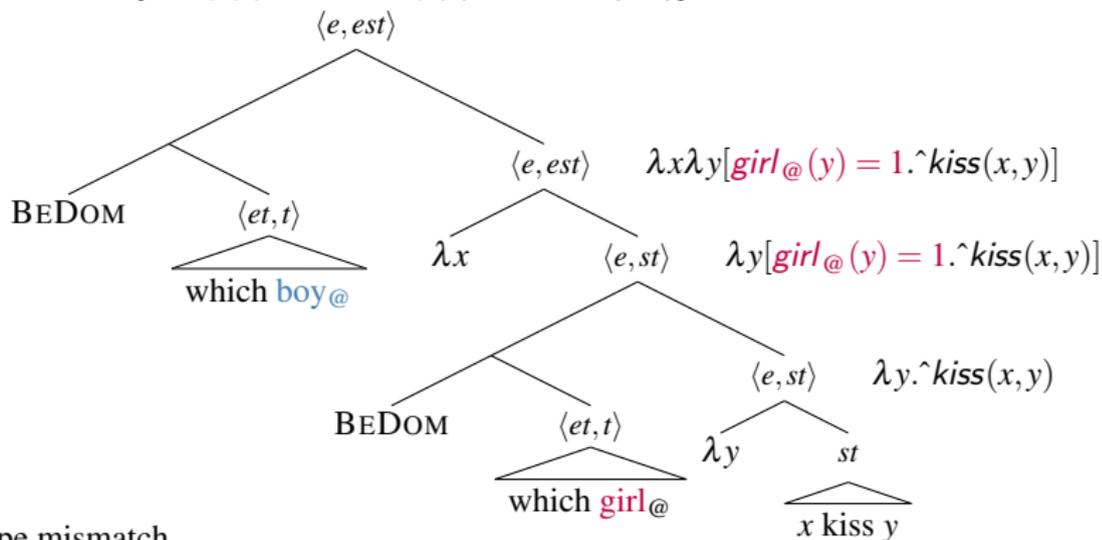
# Proposal: Composing topical properties

**BEDOM**( $\mathcal{P}$ ) is type-flexible:  $\langle \tau, \tau \rangle$

$$\text{BEDOM}(\mathcal{P}) = \lambda \theta_{\tau}. \lambda P_{\tau} [[\text{Dom}(P) = \text{Dom}(\theta) \cap \text{BE}(\mathcal{P})] \wedge \forall \alpha \in \text{Dom}(P)[P(\alpha) = \theta(\alpha)]]$$

(23) Which boy kissed which girl? (single-pair reading)

$$\begin{aligned} & \lambda x [\text{boy}_{@}(x) = 1. \lambda y [\text{girl}_{@}(y) = 1. \hat{\text{kiss}}(x, y)]] \\ & = \lambda x \lambda y [\text{boy}_{@}(x) = 1 \wedge \text{girl}_{@}(y) = 1. \hat{\text{kiss}}(x, y)] \end{aligned}$$



No type mismatch.



**a complete true answer**

$\hat{\text{came}}'(a \oplus b) / a \oplus b$

$f_{ch}$   
(choice function)

**the set of complete true answers**

$\{\hat{\text{came}}'(a \oplus b)\} / \{a \oplus b\}$

ANS/ANS<sup>S</sup>     $w$

**topical property**

$\lambda x[\text{boy}'_{@}(x) = 1. \hat{\text{came}}'(x)]$

which boy came

- ▶ **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.

## Complete true answer

- ▶ **Fox (2013)**: a true answer is complete iff it is **maximally informative** (MaxI), namely, not asymmetrically entailed by any of the true answers.

$$(24) \quad \text{ANS}_{\text{Fox}}(\mathbf{Q})(w) = \{p : w \in p \in \mathbf{Q} \wedge \forall q [w \in q \in \mathbf{Q} \rightarrow q \not\subseteq p]\}$$

(The set of MaxI true propositions in  $\mathbf{Q}$ )

$$(25) \quad \begin{array}{ll} \text{a. Who came?} & \mathbf{Q}_w = \{\hat{\text{came}}(a), \hat{\text{came}}(b), \hat{\text{came}}(a \oplus b)\} \\ \text{b. Who can chair?} & \mathbf{Q}_w = \{\hat{\diamond}\text{chair}(a), \hat{\diamond}\text{chair}(b)\} \end{array}$$

Fox's view leaves space for mention-some.

## Defining answerhood-operators

For propositional answers:

$$\text{ANS}(\mathbf{P})(w) = \{\mathbf{P}(\alpha) : \alpha \in \text{Dom}(\mathbf{P}) \wedge w \in \mathbf{P}(\alpha) \wedge \forall \beta \in \text{Dom}(\mathbf{P}) [w \in \mathbf{P}(\beta) \rightarrow \mathbf{P}(\beta) \not\subseteq \mathbf{P}(\alpha)]\}$$

For short answers:

$$\text{ANS}^{\text{S}}(\mathbf{P})(w) = \{\alpha : \alpha \in \text{Dom}(\mathbf{P}) \wedge w \in \mathbf{P}(\alpha) \wedge \forall \beta \in \text{Dom}(\mathbf{P}) [w \in \mathbf{P}(\beta) \rightarrow \mathbf{P}(\beta) \not\subseteq \mathbf{P}(\alpha)]\}$$

## Proposal: Interim summary

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

I propose that a coordination can also be interpreted as a **generalized quantifier**.

## Proposed semantics of conjunctions

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

a. **Meet**

$\llbracket A \text{ and } B \rrbracket = A' \sqcap B'$ ; defined only if  $A' B'$  are of the same conjoinable type.

b. **Generalized conjunction**

$$\begin{aligned}\llbracket A \text{ and } B \rrbracket &= A' \bar{\wedge} B' = \lambda \alpha [\alpha(A') \wedge \alpha(B')] \\ &= \lambda \alpha. \{A', B'\} \subseteq \alpha\end{aligned}$$

(The set of  $\alpha$  such that  $\alpha$  is a superset of  $\{A', B'\}$ )

When interpreted as a generalized quantifier, the domain restriction can be either monomorphic or polymorphic.

## Cf.: A seemingly similar but different approach

Partee & Rooth (1983)

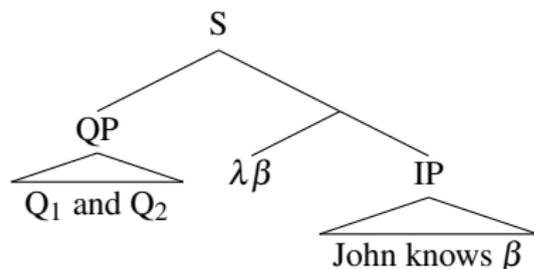
The conjunctive is a meet applied to the Montague-lifted readings of the conjuncts.

(27)  $\llbracket A \text{ and } B \rrbracket = \text{LIFT}(A') \sqcap \text{LIFT}(B')$

This approach requires  $\text{LIFT}(A')$  and  $\text{LIFT}(B')$  to be of the same conjoinable type.

- Question coordinations are generalized quantifiers.

(28) John knows  $[[Q_1 \text{ who came}] \text{ and } [Q_2 \text{ who bought what}]]$ .

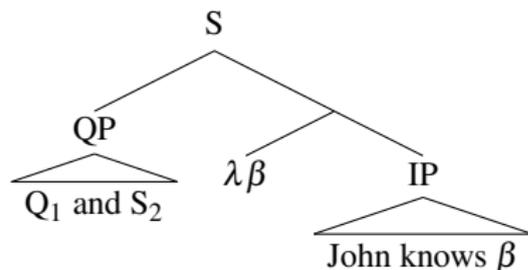


- $\llbracket \text{IP} \rrbracket = \textit{know}(j, \beta)$
- $\llbracket Q_1 \text{ and } Q_2 \rrbracket = Q'_1 \bar{\wedge} Q'_2 = \lambda \alpha. [\alpha(Q'_1) \wedge \alpha(Q'_2)]$
- $$\begin{aligned} \llbracket \text{S} \rrbracket &= (\lambda \alpha. [\alpha(Q'_1) \wedge \alpha(Q'_2)])(\lambda \beta. \textit{know}(j, \beta)) \\ &= (\lambda \beta. \textit{know}(j, \beta))(Q'_1) \wedge (\lambda \beta. \textit{know}(j, \beta))(Q'_2) \\ &= \textit{know}(j, Q'_1) \wedge \textit{know}(j, Q'_2) \\ &= \textit{know}(j, \lambda x. \hat{\textit{came}}(x)) \wedge \textit{know}(j, \lambda x \lambda y. \hat{\textit{bought}}(x, y)) \end{aligned}$$

(John knows who came, and John knows who bought what.)

- Likewise:

(29) John knows  $[[Q_1 \text{ who came}] \text{ and } [S_2 \text{ that Mary bought Coke}]]$ .



- $[[Q_1 \text{ and } S_2]] = Q'_1 \bar{\wedge} S'_2 = \lambda \alpha. [\alpha(Q'_1) \wedge \alpha(S'_2)]$
- $[[S]] = (\lambda \alpha. [\alpha(Q'_1) \wedge \alpha(S'_2)])(\lambda \beta. \textit{know}(j, \beta))$   
 $= (\lambda \beta. \textit{know}(j, \beta))(Q'_1) \wedge (\lambda \beta. \textit{know}(j, \beta))(S'_2)$   
 $= \textit{know}(j, Q'_1) \wedge \textit{know}(j, S'_2)$   
 $= \textit{know}(j, \lambda x. \hat{\textit{came}}(x)) \wedge \textit{know}(j, \hat{\textit{bought}}(m, c))$

(John knows who came, and John knows that Mary bought Coke.)

**Prediction:** A question coordination has to scope over an embedding predicate.

This prediction cannot be evaluated based on “John knows  $Q_1$  and  $Q_2$ ”, because *know* is divisive:  $know(j, S_1 \text{ and } S_2) \Leftrightarrow know(j, S_1) \wedge know(j, S_2)$

**Validation 1:**  $[Q_1 \text{ and } Q_2] > \textit{surprise}$

▶ *Surprise* is non-divisive:

- (30) John is **surprised** that [Mary went to Boston] and [Sue went to Chicago].  
(He expected them go to the same city.)  
 $\not\rightarrow$  John is surprised that Mary went to Boston.

▶ But:

- (31) John is **surprised** at [who went to Boston] and [who went to Chicago].  
 $\rightsquigarrow$  John is surprised at who went to Boston.

☞ Conjunctions of questions must scope above *surprise*.

## Validation 2: $[Q_1 \text{ or } Q_2] > \textit{know}$

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.

<i>Mary invite ...</i>	<i>a</i>	<i>b</i>	<i>a or b (or both)</i>
Fact	Yes	Yes	Yes
John's belief	?	?	Yes

- (32) a. John knows [whether Mary invited *a*] **or** [whether Mary invited *b*]. FALSE  
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 [ $Q_1$  whom John loves] or [ $Q_2$  whom Mary loves].

a. **Wide scope reading**

The speaker knows that Peter wants to know the answer to  $Q_1$  or the answer to  $Q_2$ , 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  $Q_1$  or the answer to  $Q_2$ , 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**

$[[Q_1 \text{ or } Q_2] \lambda \beta \text{ [Peter wants to know } \beta]]$

b. **Narrow scope reading**

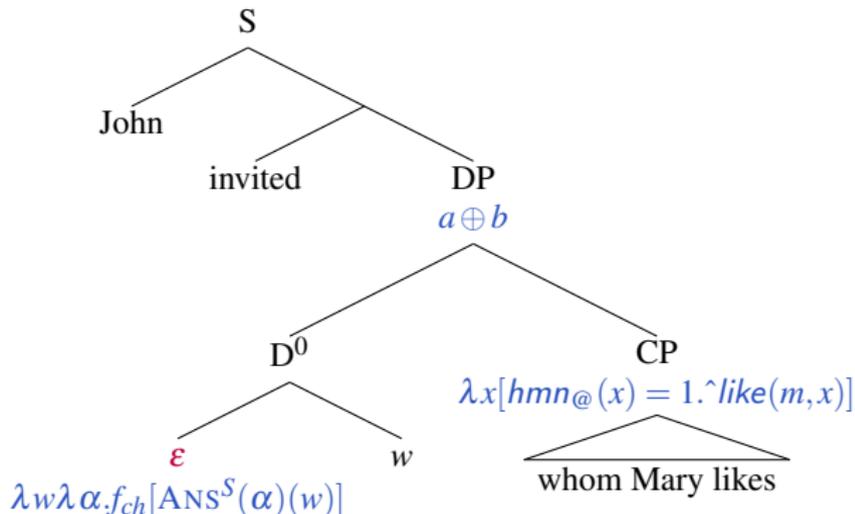
$[\text{Peter wants } [[Q_1 \text{ or } Q_2] \lambda \beta \text{ [to know } \beta]]]$

## 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.*)



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



### Example

(38) For the most part, John knows [Q which professors formed the committee].

(Context: *The committee is formed by three professors abc*)

a.  $\text{ANS}^S(\llbracket Q \rrbracket)(w) = \{a \oplus b \oplus c\}$

b.  $\text{AT}(a \oplus b \oplus c) = \{a, b, c\}$

c. QV inference:

$$\lambda w. \exists f_{ch} [\text{MOST } y [y \in \{a, b, c\}] [\text{know}_w(j, \lambda w'. y \leq f_{ch} [\text{ANS}^S(\llbracket Q \rrbracket)(w')]])]$$

- ▶ **Why pursuing a categorial approach?**
  - ① Caponigro's generalization
  - ② Some cases of quantificational variability effects
- ▶ **Problems/difficulties with traditional categorial approaches**
  - ① Existential semantics of *wh*-words
  - ② Type-mismatch in composing multi-*wh* questions
  - ③ Coordinations of questions
- ▶ **A hybrid categorial approach**
  - ▶ The root denotation of a question is a topical property.
  - ▶ A *wh*-phrase is an  $\exists$ -quantifier, but is shifted into a type-flexible domain restrictor by the application of a BEDOM-operator.
  - ▶ This topical property can supply propositional answers as well as short answers.
- ▶ **Applications**
  - ▶ Free relatives
  - ▶ Quantificational variability effects

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



Caponigro, I. 2003. Free not to ask: On the semantics of free relatives and wh-words cross-linguistically. Doctoral Dissertation, UCLA.



Ciardelli, I, and F. Roelofsen. 2015. Alternatives in Montague grammar. In *Proceedings of Sinn und Bedeutung*, volume 19, 161-178.



Ciardelli, I., F. Roelofsen, and N. Theiler. 2017. Composing alternatives. *Linguistics and Philosophy* 40:1-36.



Cremers, A. 2016. On the semantics of embedded questions. Doctoral Dissertation, École normale supérieure, Paris.



Fox, D. 2013. Mention-some readings of questions, class notes, MIT seminars.



Groenendijk, J. and M. Stokhof. 1984. *Studies in the semantics of questions and the pragmatics of answers*. Amsterdam: University of Amsterdam dissertation.



Groenendijk, J. and M. Stokhof. 1989. Type-shifting rules and the semantics of interrogatives. In *Properties, types and meaning*, 21-68. Springer.



Guerzoni, E. and Y. Sharvit. 2007. A question of strength: On NPIs in interrogative clauses. *Linguistics and Philosophy* 30:361-391.

-  Hausser, R. and D. Zaefferer. 1979. Questions and answers in a context-dependent Montague grammar. In *Formal semantics and pragmatics for natural languages*, 339-358. Springer.
-  Hausser, R. 1983. The syntax and semantics of English mood. In *Questions and answers*, 97-158. Springer.
-  Karttunen, L. 1977. Syntax and semantics of questions. *Linguistics and philosophy* 1:3-44.
-  Lahiri, U. 1991. Embedded interrogatives and predicates that embed them. Doctoral Dissertation, Massachusetts Institute of Technology.
-  Lahiri, U. 2002. *Questions and answers in embedded contexts*. Oxford University Press.
-  Partee, B. and M. Rooth. 1983. Generalized conjunction and type ambiguity. In *Meaning, use, and interpretation of language*, ed. R. Bäuerle, C. Schwarze, and A. von Stechow, 334-356. Blackwell Publishers Ltd.
-  Schwarz, B. 1994. Rattling off questions. University of Massachusetts at Amherst.
-  Uegaki, W. 2015. Interpreting questions under attitudes. Doctoral Dissertation, MIT.



Williams, A. 2000. Adverbial quantification over (interrogative) complements. In *Proceedings of WCCFL 19*, 574-587.



Xiang, Y. 2016. Interpreting questions with non-exhaustive answers. Doctoral Dissertation, Harvard University.