Composing questions: A hybrid categorial approach

Questions have been defined as lambda (λ-)abstracts (as in categorial approaches, Hausser 1983, a.o.), sets of propositions (as in Hamblin-Karttunen Semantics), or partitions (as in Partition Semantics, Gr&S 1984). Recently, categorial approaches are less commonly used due to their deficiencies in semantic compositions. Nevertheless, several facts suggest that question denotations should be able to supply not only *propositional* meanings but also *predicative* and *nominal* meanings. For example, *wh*-words have a strictly more limited distribution in free relatives (FRs) than in questions, which suggests that *wh*-FRs are formed out of *wh*-questions (Caponigro & Chierchia 2013): in languages with *wh*-FRs, any *wh*-word that can be used in FRs can also be used in questions, but not the other direction (Caponigro 2003). Facts as such imply that λ-abstracts are the most likely question denotations: from λ-abstracts, we can easily get the predicative/nominal meanings and derive Hamblin sets or partitions, but we cannot retrieve λ-abstracts from Hamblin sets or partitions.

This paper proposes a hybrid categorial approach of question semantics. It revives the idea that questions denote λ-abstracts. It also overcomes the deficiencies of traditional categorial approaches.

Traditional categorial approaches define questions as λ-abstracts, as in (1c-d), and *wh*-words as λ-operators, as in (1a-b).

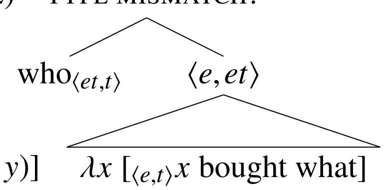
(1) a. $[\![\text{who}]\!] = \lambda P_{\langle e,t\rangle}\lambda x[\mathsf{man}(x).P(x)]$

b. $[\![\text{what}]\!] = \lambda P_{\langle e,t\rangle}\lambda x[\mathsf{thing}(x).P(x)]$

c. $[\![\text{who came}]\!] = \lambda x[\mathsf{man}(x).\mathsf{came}(x)]$

d. $[\![\text{who bought what}]\!] = \lambda x\lambda y[\mathsf{man}(x) \wedge \mathsf{thing}(y).\mathsf{bought}(x,y)]$

(2) TYPE MISMATCH!

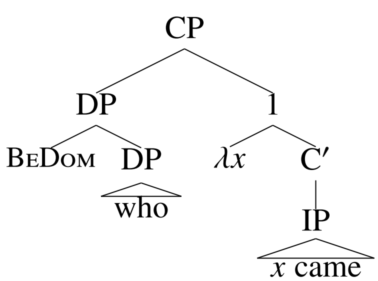


This treatment has the following three problems. **Problem(P)1**, defining *wh*-words as λ-operators, it cannot capture the cross-linguistic existential semantics of *wh*-words in non-interrogative sentences. **P2**, as illustrated in (2), the composition of the single-pair reading of a multi-*wh* question suffers type mismatch: *who* is of type $\langle et,t\rangle$, while its sister node is of type $\langle e,et\rangle$. **P3**, it has difficulties in getting question coordinations in (3). Categorial approaches assign different questions with different types, but it is standardly assumed that coordinated items must be of the same conjoinable type.

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

Proposal: A hybrid categorial approach I maintain the view that *wh*-items denote $\exists$-quantifiers (Karttunen 1977), as in (4a) (avoiding **P1**), and define the root denotation of a question as a topical property, namely, a function from the domain of the *wh*-item to the Hamblin set, as in (4c) and (5b).

(4) Who came?

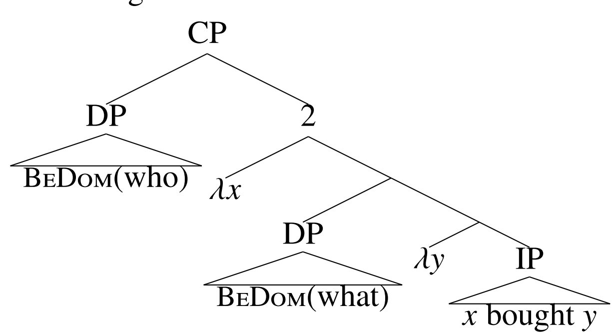


a. $[\![\text{who}]\!] = \lambda P.\exists x[\mathsf{man}(x) \wedge P(x)]$

b. $[\![1]\!] = \lambda x[x \in D_e.\hat{}\mathsf{came}(x)]$

c. $[\![\text{CP}]\!] = \lambda x[\mathsf{man}(x).\hat{}\mathsf{came}(x)]$

(5) Who bought what?



a. $[\![2]\!] = \lambda x\lambda y[x \in D_e \wedge \mathsf{thing}(y).\hat{}\mathsf{bought}(x,y)]$

b. $[\![\text{CP}]\!] = \lambda x\lambda y[\mathsf{man}(x) \wedge \mathsf{thing}(y).\hat{}\mathsf{bought}(x,y)]$

The key technique for composition is a BeDom-operator. In syntax, it adjoins to a *wh*P and moves together to [Spec, CP]. In semantics, it shifts an existential quantifier $\mathcal{P}$ into a type-flexible domain restrictor: as defined in (6), BeDom($\mathcal{P}$) applies to a function θ (of an arbitrary type) and restricts the domain of θ with the quantification domain of $\mathcal{P}$ (i.e., the set Be($\mathcal{P}$)). The output partial property P has the identical semantic type as the input property θ. For example, in (4), since Be($[\![\text{who}]\!]$) = man, 'BeDom(who)' applies to a total came-property defined for any item of type e, and returns a partial came-property only defined for human. Likewise, in (5), 'BeDom(who)' applies to a total function of type $\langle e, est\rangle$ and returns a similar function only defined for human. Superior to traditional categorial approaches, this way of composition does not suffer type mismatch, solving **P2**.

(6) $\text{BeDom}(\mathcal{P}) = \lambda\theta_\tau.\iota P_\tau[[\text{Dom}(P) = \text{Dom}(\theta)\cap \text{Be}(\mathcal{P})] \wedge \forall\alpha \in \text{Dom}(P)[P(\alpha) = \theta(\alpha)]]$
where $\text{Be} = \lambda\mathcal{P}\lambda z[\mathcal{P}(\lambda y.y = z)]$ (Partee 1986) and τ is an arbitrary type.

Getting question coordinations I propose that conjunction *A and B* can be interpreted either as meet $A'\sqcap B'$ (Partee & Rooth 1982) or as generalized conjunction $A'\bar{\wedge}B'$. In particular, $A'\bar{\wedge}B'$ is a generalized universal quantifier over the set $\{A', B'\}$. Disjunction *A or B* is interpreted analogously.

(7) A conjunction "A and B" is ambiguous between (a) or (b):

a. $[\![A \text{ and } B]\!] = A'\sqcap B'$; defined only if A' and B' are of the same conjoinable type.

b. $[\![A \text{ and } B]\!] = A'\bar{\wedge}B' = \lambda\alpha[\alpha(A')\wedge\alpha(B')]$

In responding to **P3**, I argue that question coordinations are generalized quantifiers, and hence that questions of different types can be coordinated. For example, in (8), the embedded question coordination is a generalized conjunction. It takes QR and scopes above *know*.

(8) John knows [$_{Q_1}$ who came] and [$_{Q_2}$ who bought what].

a. LF: [$_S$ [Q_1 and Q_2] $\lambda\beta$ [John knows β]]

b. $[\![Q_1 \text{ and } Q_2]\!] = [\![Q_1]\!]\bar{\wedge}[\![Q_2]\!] = \lambda\alpha.[\alpha(Q'_1)\wedge\alpha(Q'_2)]$

c. $[\![S]\!] = \lambda\alpha.[\alpha(Q'_1)\wedge\alpha(Q'_2)](\lambda\beta.\mathsf{know}(j,\beta)) = (\lambda\beta.\mathsf{know}(j,\beta))(Q'_1)\wedge(\lambda\beta.\mathsf{know}(j,\beta))(Q'_2)$
$= \mathsf{know}(j, Q'_1)\wedge\mathsf{know}(j, Q'_2)$

This analysis predicts that an embedded coordination of question must take scope above the embedding predicate. This prediction is supported by the contrast in (9). Since *surprise* isn't divisive, being surprised at the conjunction of two propositions *p and q* does not necessarily imply being surprised at each propositional conjunct, while being surprised at the conjunction of two questions Q_1 *and* Q_2 does entail being surprised at each question. This is so because *p and q* is ambiguous between meet and generalized conjunction, while Q_1 *and* Q_2 has to be generalized conjunction.

(9) a. John is surprised that [Mary went to Boston] and [Sue went to Chicago]. (He expected that them would go to the same city.) $\not\rightsquigarrow$ *John is surprised that Mary went to Boston.*

b. John is surprised at [who went to Boston] and [who went to Chicago].
$\rightsquigarrow$ *John is surprised at who went to Boston.*

In case that the embedding predicate is intensional (e.g., *wonder*, *investigate*), the seeming narrow scope readings also involve QR of the question coordination. For example, decomposing *wonder* into *want to know* (Uegaki 2015, a.o.), the narrow scope reading of (10) is obtained if the question coordination is raised to a scope position between *want* and *know* (compare Gr&S 1989).

(10) Peter wonders [$_{Q_1}$ whom John loves] or [$_{Q_2}$ whom Mary loves].
LF for narrow scope reading: [Peter wants [[Q_1 or Q_2] $\lambda\beta$ [to know β]]]