Hamblin-Karttunen Semantics

1. Hamblin Semantics of questions

1.1. Basic assumptions (Hamblin 1973)

- Answers of questions are all statements. A short answer is an elliptical form of the corresponding full answer.

(1) Who came?
  a. Mary came. (full answer)
  b. Mary ~~came~~. (short answer)

The root denotation of a question is the set of propositions that are **possible** answers of this question, called a "Hamblin (alternative) set". (Hamblin didn't explicitly say what counts a possible answer. We typically consider only "direct answers".)

(2) a. $[\![\text{Who came?}]\!] = \{\text{a came, b came, a and b came, ...}\}$
  b. $[\![\text{Which person invited which person?}]\!] = \{\text{a invited b, b invited a, ...}\}$
  c. $[\![\text{How many cats does John have?}]\!] = \{\text{John has one cat, John has two cats, ...}\}$
  d. $[\![\text{Did John come?}]\!] = \{\text{John came, John didn't come}\}$
  e. $[\![\text{Does Mary like coffee or tea?}_{\text{ALT-Q}}]\!]$
  $= \{\text{Mary likes coffee, Mary likes tea}\}$
  f. $[\![\text{Does Mary like coffee or tea?}_{\text{Y/N-Q}}]\!]$
  $= \{\text{Mary likes coffee or tea, Mary doesn't like coffee or tea}\}$

- Lexical expressions are set-denoting. From a type-theoretic point of view, an expression of type τ is enriched to $\langle \tau, t \rangle$.

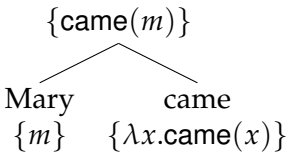
(3) a. $[\![\text{Mary}]\!]^{w,g} = \{m\}$
  b. $[\![\text{came}]\!]^{w,g} = \{\lambda x.\text{came}(x)\}$
  c. $[\![t_1]\!]^{w,g} = \{g(1)\}$

These sets combine compositionally via *Point-wise Functional Application*.

(4) **Point-wise Functional Application (PFA)**
If $\{\alpha, \beta\}$ is the set of γ's daughter nodes, $[\![\alpha]\!]^{w,g} \subseteq D_{\langle\sigma,\tau\rangle}$ and $[\![\beta]\!]^{w,g} \subseteq D_\sigma$, then
$[\![\gamma]\!]^{w,g} = \{a(b) \mid a \in [\![\alpha]\!]^{w,g} \wedge b \in [\![\beta]\!]^{w,g}\}$
(or equivalently: ... $[\![\gamma]\!]^{w,g} = \{x \mid \exists a \in [\![\alpha]\!]^{w,g} \exists b \in [\![\beta]\!]^{w,g} [x = a(b)]\}$)

Example:

(5) Mary came.



- Existential indefinites and *wh*-items denote sets of elements in their domain restrictions.

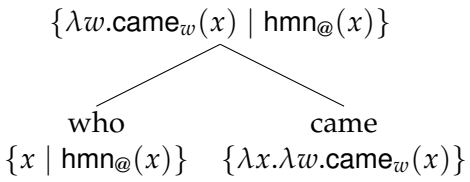
(6) a. $[\![\text{who}]\!]^{w,g} = [\![\text{someone}]\!]^{w,g} = \{x \mid \mathsf{hmn}_w(x)\}$
b. $[\![\text{what}]\!]^{w,g} = [\![\text{something}]\!]^{w,g} = \{x \mid \mathsf{thing}_w(x)\}$
c. $[\![\text{which cat}]\!]^{w,g} = \{x \mid \mathsf{cat}_w(x)\}$

1.2. Composing questions

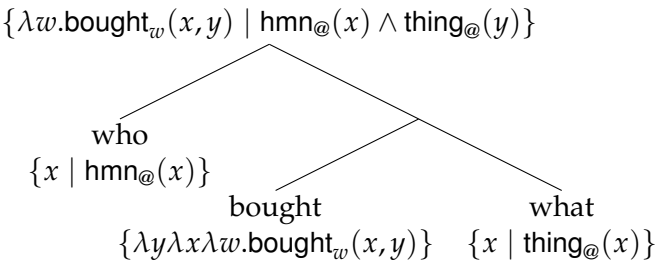
1.2.1 Composing *wh*- and polar questions using (traditional) Hamblin Semantics

- **For *wh*-questions**: *Wh*-phrases combine with the remnant via PFA.

(7) Who came?



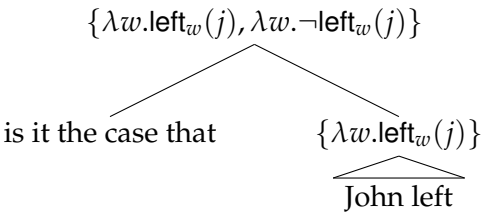
(8) Who bought what?



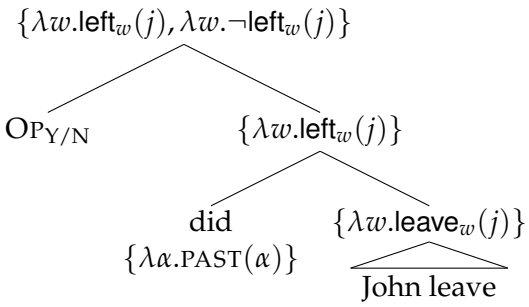
- **For polar questions**: The adverbial *is it the case that/whether* is defined as the set with the identity function on the question nucleus and its negation.

(9) $[\![\text{is it the case that/whether/OP}_{Y/N}]\!] = \{\lambda p.p,\ \lambda p\lambda w.\neg p_w\}$

(10) Is it the case that John left?



(11) Did John leave?

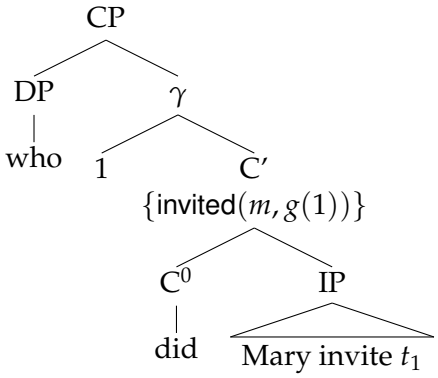


1.2.2 More on *wh*-movement and Predicate Abstraction

- Hamblin Semantics is particularly well-suited for *wh*-insitu languages (e.g., Japanese; see Hagstrom 1998; Shimoyama 2001; Kratzer and Shimoyama 2002). In contrast, in categorial approaches and Karttunen Semantics, (non-subject) *wh*-items must undertake movement to salvage type-mismatch.

  But, how can we use Hamblin Semantics to compose an LF that involves *wh*-movement? This issue is non-trivial, since we haven't introduced how to do Predicate Abstraction (PA) over Hamblin sets.

(12) Who did Mary invite?



Attempt 1: if the γ-node is composed via the naive PA rule, it clearly cannot combine with the moved *wh*-phrase via PFA.

(13) **Predicate Abstraction**
For a branching node $[_\gamma n\ \beta]$ where n is an index, $[\![\gamma]\!]^{w,g} = \lambda x.[\![\beta]\!]^{w,g[n\to x]}$

(14) $[\![\gamma]\!]^{w,g} = \lambda x.[\![\text{C}']\!]^{w,g[1\to x]}$
$= \lambda x.\{\textsf{invited}_w(m, g[1 \to x](1))\}$
$= \lambda x.\{\textsf{invited}_w(m, x)\}$

Attempt 2: **Hamblinized Predicate Abstraction** (Hagstrom 1998; Kratzer and Shimoyama 2002)

(15) For a branching node $[_\gamma n\ \beta]$ where n is an index and $[\![\beta]\!]^{w,g} \subseteq D_\tau$,
$[\![\gamma]\!]^{w,g} = \{f_{\langle e,\tau\rangle} \mid \forall x[f_w(x) \in [\![\beta]\!]^{w,g[n\to x]}]\}$

(16) $[\![\gamma]\!]^{w,g} = \{f_{\langle e,st\rangle} \mid \forall x[f_w(x) \in [\![\text{C}']\!]^{w,g[1\to x]}]\}$
$= \{f_{\langle e,st\rangle} \mid \forall x[f_w(x) \in \{\textsf{invited}_w(m, g[1 \to x](1))\}]\}$
$= \{f_{\langle e,st\rangle} \mid \forall x[f_w(x) \in \{\textsf{invited}_w(m, x)\}]\}$
$= \{f_{\langle e,st\rangle} \mid \forall x[f_w(x) = \textsf{invited}_w(m, x)\}$
$= \{\lambda x.\textsf{invited}(m, x)\}$

- **Discussion:** Compose the multi-*wh* question (20b) using the above Hamblinized PA rule. Does this composition return the same Hamblin set denotation as in (20a)?

(17) a. Which student read which book?
b. Which book did which student read?

- So far looks fine. But, as admitted by Kratzer and Shimoyama (2002), the Hamblinized PA rule is quite questionable. For discussions of the problems and solutions, see Shan (2004), Poesio (1996), Novel and Romero (2010), Charlow (2014), and Ciardelli and Roelofsen (2015).

1.2.3 Composing disjunctive questions

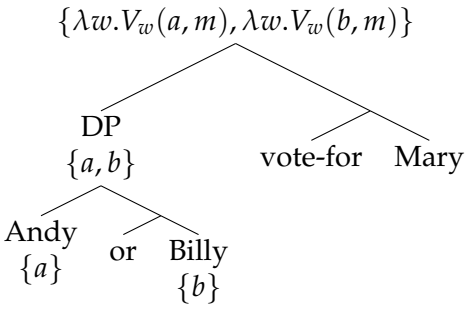
- Disjunctive questions have two readings — the alternative question (AltQ) reading and the polar question (PolQ) reading.

(18) a. Did Andy$_{/}$ or BILly$_{\backslash}$ vote for Mary?
'I want to know which of the two voted for Mary.' AltQ

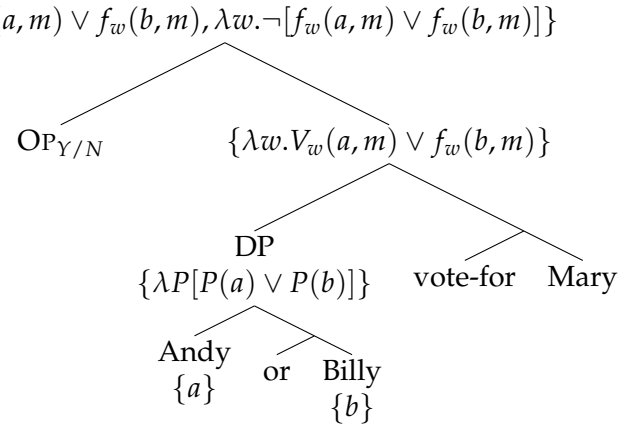
b. Did Andy or Billy vote for MAry?
'I want to know whether one of the two voted for Mary.' PolQ

- Hamblin (1973) didn't discuss disjunctive questions. Let's first consider a naive option that defines the disjunctive *or* ambiguously either as a **union operation** or as a **boolean disjunctive**.

(19) a. AltQ reading: Let $[\![\text{or}]\!] = \lambda\alpha_{\langle\tau,t\rangle}\lambda\beta_{\langle\tau,t\rangle}.\alpha \cup \beta$. Compose DP by FA.



b. PolQ reading: Let $[\![\text{or}]\!] = \{\lambda y\lambda x\lambda P[P(x) \vee P(y)]\}$. Compose DP by PFA.



Problem: The choices of (P)FA and (non-)set-meaning are pretty ad hoc. We should either make the choices more principled (I) or make the lexicon and the composition rule uniform (II, III).

I **Two-tier Alternative Semantics analyses** (Shimoyama 2001, 2006; Beck and Kim 2006; Beck 2006; Biezma and Rawlins 2012, 2015; Kotek 2014; Uegaki et al. 2018; among others)
These approaches make use of Rooth's two-tier Alternative Semantics, which gives an expression two values: an *ordinary* (i.e., non-set) *value* and an *alternative value*. Varying by F-marking, the disjunctive *or* makes different semantic contributions: it contributes a simple boolean disjunction in PolQs while introduces alternatives in AltQs.

II **Inquisitive Semantics analysis** (Theiler 2014; Ciardelli and Roelofsen 2015; Ciardelli et al. 2017)
This approach restores the standard type-theoretic operations of function application and abstraction.

III **Quantificational analyses** (Karttunen 1977; Heim 1995/2012, class notes)
The quantificational disjunctive operator is semantically unambiguously boolean but scopally ambiguous relative to a question particle.

2. Two-tier Alternatives Semantics

2.1. Alternative Semantics of focus (Rooth 1985, 1992)

- An expression A is assigned with two meanings: an **ordinary value** $[\![A]\!]_O$ and a **focus value/ focus alternatives** $[\![A]\!]_F$. The ordinary value is the one that we already know. The focus value is a set of meanings, where each of these meanings belongs to the same domain as the ordinary meaning.

(20) **Composing focus value**

a. If A is F-marked and is of semantic type τ, then $[\![A]\!]_F = D_\tau$.

b. If A is not F-marked:

i. Terminal Node (TN)
if A is a terminal node, $[\![A]\!]_F = \{[\![A]\!]_O\}$;

ii. Non-branching Node (NN)
if A is a non-branching node that dominates B, $[\![A]\!]_F = [\![B]\!]_F$;

iii. Point-wise Functional Application (PFA)
for any branching node $[_A\ B\ C]$, if $\oplus$ is the combination operation s.t. by the ordinary semantic rules $[\![A]\!]_O = [\![B]\!]_O \oplus [\![C]\!]_O$, then $[\![A]\!]_F = \{b \oplus c \mid b \in [\![B]\!]_F \text{ and } c \in [\![C]\!]_F\}$.

Exercise: Compute the focus value of the following sentence compositionally:

(21) JOHN$_F$ invited Billy.

2.2. Alternative Semantics of questions

- For *wh*-questions: (the composition rules are the same as in (20) except that '$_F$' is replaced with '$_{Alt}$'.)

(22) a. $[\![\text{who}]\!]_O$ is undefined

b. $[\![\text{who}]\!]_{Alt} = \{x \mid \mathsf{hmn}_@(x)\}$

c. $[\![[_{\text{TP}}\ \text{who came}]]\!]_O$ is undefined

d. $[\![[_{\text{TP}}\ \text{who came}]]\!]_{Alt} = \{\hat{}\mathsf{came}(x) \mid \mathsf{hmn}_@(x)\}$

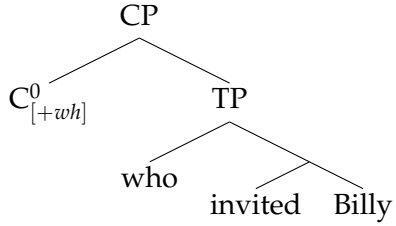
e. $[\![\text{C}^0_{[+wh]}\ [\text{TP}]\ ]\!]_O = [\![\text{TP}]\!]_{Alt}$ (Shimoyama 2001, Beck & Kim 2006)
(interrogative C^0 returns the alternative value of TP as the ordinary value of CP.)

NB: We cannot say that the ordinary value of a question is undefined.

(23) **Principle of Interpretability** (Beck 2006: p. 16)
An LF must have an ordinary semantic value.

Exercise: Compose the following toy LF.

(24) Who invited Billy?

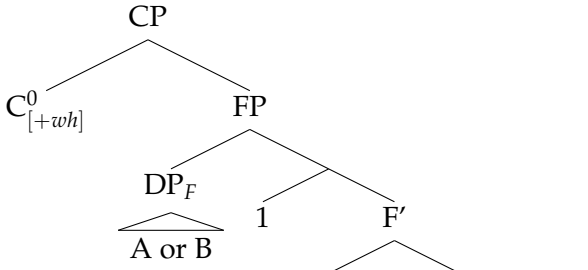


- For disjunctive questions: The AltQ/PolQ-ambiguity of disjunctive questions is due to meaning variation of the disjunction resulted from focus-marking.

– F-marking a disjunction triggers a meaning rule that introduces (domain) alternatives, leading to an AltQ reading;

(25) **Focused disjunction interpretation rule** (Beck and Kim 2006)
For a disjunction $\alpha = [\beta \; or \; \gamma]$: $[\![\alpha_F]\!]_O$ is undefined, and $[\![\alpha_F]\!]_{Alt} = [\![\beta]\!]_{Alt} \cup [\![\gamma]\!]_{Alt}$.

(26) Did [Andy or BILly]$_F$ invite Mary? (AltQ)

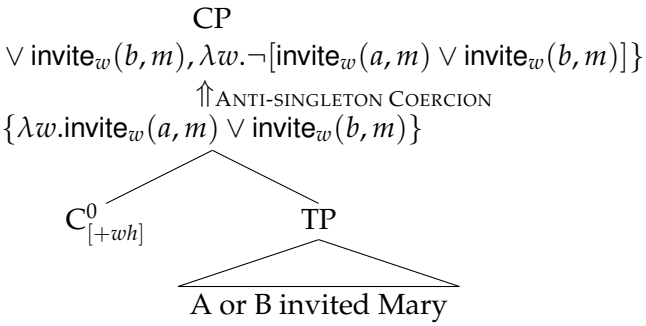


a. $[\![\text{FP}]\!]_O$ is undefined
b. $[\![\text{FP}]\!]_{Alt} = \{\hat{}\mathsf{invited}(x, m) \mid x \in \{a, b\}\}$
c. $[\![\text{CP}]\!]_O = [\![\text{FP}]\!]_{Alt} = \{\hat{}\mathsf{invited}(x, m) \mid x \in \{a, b\}\}$

– An unfocussed disjunction contributes its usual boolean meaning, leading to a PolQ reading.

(27) **Anti-singleton Coercion** (Biezma and Rawlins 2012)
If $|[\![\alpha_{\langle st,t\rangle}]\!]| = 1$, then α can be coerced (as a last resort) into the denotation $\{\{p, \lambda w.\neg p_w\} \mid p \in [\![\alpha]\!]\}$

(28) Did Andy or Billy invite MAry? (PolQ)



2.3. Question-answer congruence

- Focus-marking affects the suitability of a sentence as an answer of the given question. Observe the prosodic dependence between questions and answers. (Von Stechow 1990; Rooth 1985, 1996)

(29) Who invited Billy?
a. JOHN invited Billy.
b. # John invited BILly.

- Rooth (1992: 86): A sentence S is a possible answer of a question Q only if $[\![\text{Q}]\!]_O \subseteq [\![\text{S}]\!]_F$.

(30) a. $[\![\text{Who invited Billy?}]\!]_O \subseteq [\![\text{JOHN}_F \text{ invited Billy}]\!]_F$
b. $[\![\text{Did [John or MAry]}_F \text{ invited Billy?}]\!]_O \subseteq [\![\text{JOHN}_F \text{ invited Billy}]\!]_F$

3. Karttunen Semantics

3.1. Core assumptions of Karttunen (1977)

- The root denotation of a question is a set of propositions, each of which is a **true** answer of this question. We called this set a "Karttunen set" (cf. the Hamblin set is world-independent).

  Karttunen's motivation of introducing world-dependency: Indirect questions that use a non-veridical interrogative-embedding predicate (e.g., *tell*, *predict*) take veridical readings; the veridicality of *tell* in (31b) should come from the embedded question.[1]

  (32) a. John told us that Mary left. $\not\rightsquigarrow$ *Mary left.*
  b. John told us who left. $\rightsquigarrow$ *For some true answer p as to who came, John told us p.*

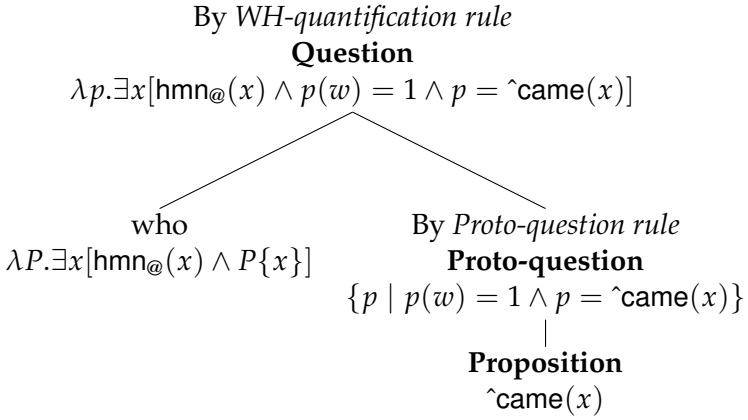
- *Wh*-words are existentially quantified noun phrases, semantically equivalent to the corresponding existential indefinites.

  (33) $[\![\text{who}]\!]^w = [\![\text{someone}]\!]^w = \lambda P_{\langle et,t\rangle}.\exists x[\mathsf{hmn}_w(x) \wedge P\{x\}]$

- Composition (Using PTQ by Montague)

  – A *proto-question rule* shifts the meaning of declarative sentence from a proposition to a *proto-question*, namely, the a set of true propositions that are identical to this proposition.
  – For *wh*-questions, the *wh*-item takes QR and quantifies into the proto-question via a *WH-question rule*, yielding a set of true answers.

  (34)



  – For alternative questions and polar questions, the Karttunen sets are derived via applying an *Alternative question rule* and an *Yes/No question rule* to a proto-question, respectively.

  (35) a. $[\![\text{whether Mary smokes or Bill drinks (AltQ)}]\!]^w$
  $= \lambda p[p(w) = 1 \wedge [p = \hat{}\mathsf{smoke}(m) \vee p = \hat{}\mathsf{drink}(b)]]$
  b. $[\![\text{whether Mary smokes or Bill drinks (PolQ)}]\!]^w$
  $= \lambda p[p(w) = 1 \wedge [p = \hat{}[\mathsf{smoke}(m) \vee \mathsf{drink}(b)] \vee p = \hat{}[\neg\mathsf{smoke}(m) \wedge \neg\mathsf{drink}(b)]]$

[1] Spector & Egré (2015) disagree with this claim — declarative-embedding *tell* does admit a factive/veridical reading.

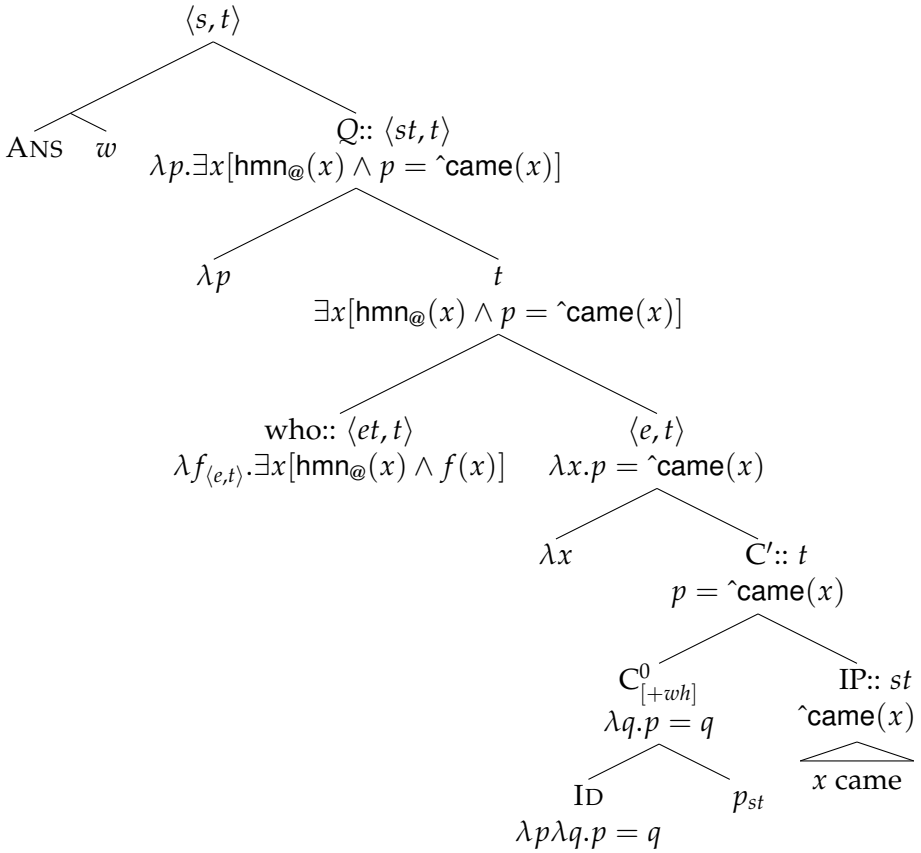
(31) a. Sue told Jack that Fred is the culprit. $\not\rightsquigarrow$ *Fred is the culprit.*
b. Sue didn't tell Jack that Fred is the culprit. $\rightsquigarrow$ *Fred is the culprit.*
c. Did Sue tell Jack that Fred is the culprit? $\rightsquigarrow$ *Fred is the culprit.*

3.2. Transporting Karttunen Semantics into a GB-style LF

3.2.1 Composing *wh*-questions (Heim 1995; a.o.)

The formalization of Karttunen Semantics follows Montague's Proper Treatment of Quantification (PTQ). Subsequent works transport the PTQ-style structures of Karttunen Semantics into Government and Binding (GB-)style LFs. The following tree illustrates the idea of Heim (1995, class notes). Different GB-style LFs have been proposed by Cresti (1995), Dayal (1996), Beck and Rullmann (1999), among others.

(36) Who came?



1. The proto-question rule is ascribed to an identify (ID)-function at the C^0.
2. The *wh*-word is an existential generalized quantifier. It undertakes QR to [Spec, $CP_{[+wh]}$] and quantifies into an identity relation.
3. Abstracting the first argument p of ID returns a Hamblin set, which is the question denotation.[2]

   (37) $Q = \lambda p.\exists x[\mathsf{hmn}_{@}(x) \wedge p = \hat{}\mathsf{came}(x)]$
   $= \{\hat{}\mathsf{came}(x) \mid x \in \mathsf{hmn}_{@}\}$

4. An answerhood (ANS)-operator applies to the Hamblin set Q and the evaluation world w, returning the/a complete true answer in w. (Unlike Karttunen (1977), truth is introduced by the ANS-operator.) Many different ANS-operators have been proposed in the literature.

   (38) $\text{ANS}_{Heim}(Q)(w) = \bigcap\{p \mid w \in p \in Q\}$ (Heim 1994)
   (The conjunction of all the true propositions in Q.)

   (39) $\text{ANS}_{Dayal}(Q)(w) = \exists p[w \in p \in Q \wedge \forall q[w \in q \in Q \rightarrow p \subseteq q]].$
   $\iota p[w \in p \in Q \wedge \forall q[w \in q \in Q \rightarrow p \subseteq q]]$ (Dayal 1996)
   (The unique strongest true proposition in Q.)

[2] The abstraction of the argument p can be viewed as a result of an answerhood-operator (Nicolae 2013).

- **Exercise:** Following (36), compose the following multi-*wh* question (w. single-pair reading).

  (40) Who bought what?

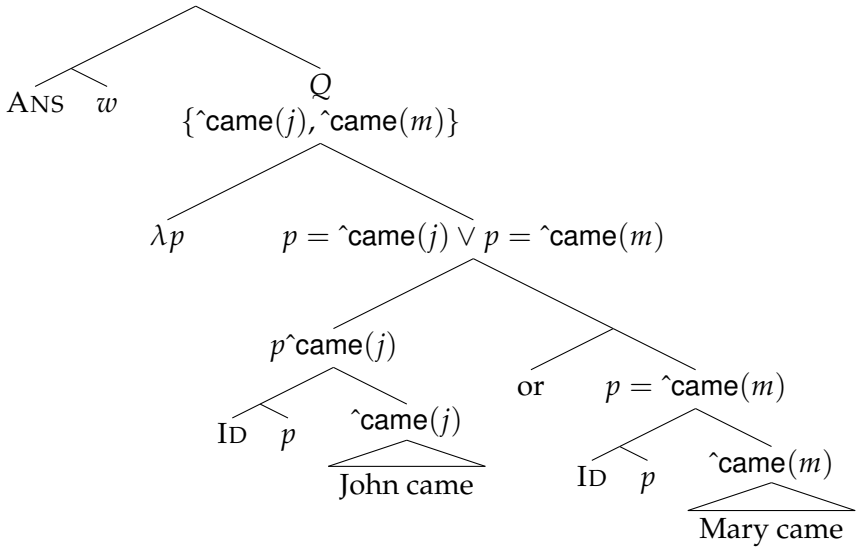
- **Hamblin Semantics vs. Karttunen Semantics:**

	Hamblin (1973)	Karttunen (1977)	GB-Transformed Karttuen
A declarative denotes	a singleton proposition set	a proposition	a proposition
A question denotes	a Hamblin set	a Karttunen set	a Hamblin set
A *wh*-word denotes	a set of individuals	an $\exists$-quantifier	an $\exists$-quantifier
Composition rules	PFA etc.	Montague PTQ	FA etc.

3.2.2 Composing alternative and polar questions

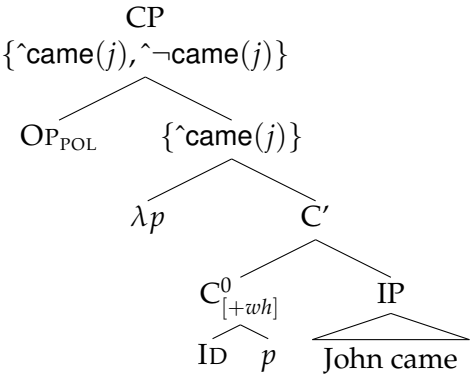
- **Alternative questions** (Note: here *or* is a connective of truth values.)

  (41) Did JOHN come or MARY come?



- **Polar questions** (after Heim 2012, class notes)

  (42) Did John come?



The abstraction of p can be viewed as a result of moving a partition-forming operator OP_{POL}. This operator applies to a singleton set with the question nucleus (i.e., the proto-question) and returns a partition. A partition divides all the set of possible worlds into cells that are mutually exclusive and collectively exhaustive. For a proposition set Q, two worlds w and w' are cell-mates relative to Q iff for every proposition p in Q, p has the same truth value in w and w'.

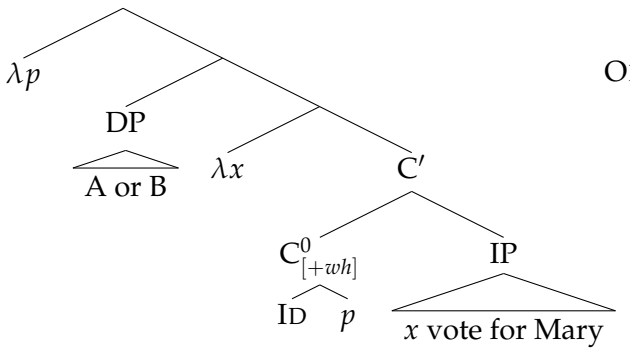
(43) $[\![\text{OP}_{\text{POL}}]\!] = \lambda Q_{\langle st,t\rangle}.\{\lambda w.\forall p \in Q[p(w) = p(w')] \mid w' \in W\}$

- **Discussion:** In composing *wh*-questions and alternative questions, the p variable (i.e., the argument of ID) is a trace of the ANS-operator. If we instead treat it as a trace of the partition-forming operator, what question denotations would be predicted?

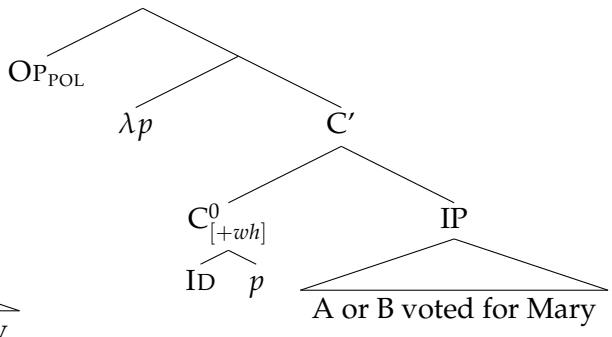
- **Polar-Alternative Ambiguity**

(44) Did Andy or Billy vote for Mary?

a. Alternative question reading



b. Polar question reading



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