Questions, Answers and the Structuring of Information: Theories of the Question / Answer Relation

Manfred Krifka

Centre de Lingüística Teòrica
Departament de Filologia Catalana
Universitat Autònoma de Barcelona

September 5 – 7, 2016

Zentrum für Allgemeine Sprachwissenschaft
HUMBOLDT-UNIVERSITÄT ZU BERLIN

BERLIN SCHOOL OF MIND AND BRAIN

Goals and Overview

From the abstract: In this mini-course, I will give an overview of recent semantic approaches to the meaning of questions and to the relation of appropriate answers to questions. One central aspect will be the role of focus marking in establishing this relation — e.g., why can the constituent question *Who praised Mary?* be answered with *JOHN praised Mary, but not with John praised MARY.* I will also discuss recent research on the relation between polarity questions and their answers — e.g., why can the question *Did John not praise Mary?* be answered by *no* and *yes* with the same intended meaning (that he did not praise her), and what distinguishes this question from *Didn't John praise Mary?*, where the answers *no* and *yes* are unambiguous. Furthermore, I will discuss focus in polarity questions, as in *Did JOHN praise Mary?,* where we have to explain why the answer *No* is felt to be incomplete and needs additions like … *BILL did.* Also, I will deal with focus in constituent questions, such as *Who PRAISED Mary?*, which suggest that other questions, like *Who CRITICISED Mary?* are in the background. Finally, I will also discuss biased questions and question tags, as in *John praised Mary, did he? / didn't he?*

Structure:

- Day 1: Theories of the Question / Answer Relation
- Day 2: Response Particles to Assertions and Polarity Questions
- Day 3: Questions and answers in Commitment Space Semantics

Slides can be downloaded from:

- http://www.zas.gwz-berlin.de/180.html
- or http://www.zas.gwz-berlin.de/mitarbeiter_krifka.html, go to "Vorträge" or "Talks"

I. Theories of the Question / Answer Relation

Goal:

- A history of approaches to the semantics of questions
- with an eye on the formal relationship between different approaches
- based largely on Krifka 2011[1]

From the abstract:

Day 1: Review of the basics of semantic representation and workable assumptions for the syntax/semantics interface. Theories for the semantic interpretation of constituent questions (questions as functions, as set of propositions, as partititions of the logical space, as inquisitive meanings) and for the interpretation of focus in congruent answers. See in particular the survey article, Krifka 2011.

[1] Krifka, Manfred. 2011. Questions. In: Maienborn, Claudia, Klaus von Heusinger & Paul Portner, (eds), *Semantics. A handbook of natural language meaning*. Berlin: Mouton de Gruyter, 1742-1785.

1 Questions as speech acts / semantic objects

1.1 Searle's classification

Classification of speech acts, Searle 1975:[2]

- **Assertives** = speech acts that commit a speaker to believing the expressed proposition
- Directives = speech acts that are to cause the hearer to take a particular action (Footnote a: "**Questions** are a species of directives since they are attempts by S to get H to answer - i.e. to perform a speech act.")
- Commissives = speech acts that commit a speaker to doing some future action
- Expressives = speech acts that express the speaker's attitudes and emotions towards the proposition
- Declarations = speech acts that change social facts in accord with the proposition of the declaration

Notice:

- Assertives are treated as a main type of speech acts
- Questions just as a subtype of another type of speech acts

[2] Searle, John. 1976. A classification of illocutionary acts. *Language in Society* 5: 1-23.

1.2 Problems with Searle's classification

- Not a necessary criterion, as not every question requests information
  – rhetorical questions: *Did you ever lift a finger to help me?*
  – exam questions: *Who founded Rome, and when?*
  – deliberative questions:
  Ob Peter noch immer kubanische Zigarren raucht?
  'I wonder whether Peter still smokes Cuban cigars', Truckenbrodt 2006
  – questions as requests for an action, e.g. *Can you help me?* (indirect speech act)
  – Expression of conditions: *Are you easily tired? XYZ will help you.*
- Not a sufficient criterion, requests for answers / information also by imperatives,
  – *Tell me the time.*
- Does not correspond to the classification of major sentence types by linguists:
  "Three basic sentence types are traditionally distinguished for European languages and have also been found useful for many other languages: declarative, interrogative and imperative sentences." (König & Siemund 2007)[3]
- Does not deal with embedded questions:
  – *Ed knows whether Ann will come / who will come.*
  – *Ed wonders whether Ann will come. / who will come.*
- Does not recognize the specific relation between questions and assertives (answers)

[3] König, Ekkehard & Peter Siemund. 2007. Speech act distinctions in grammar. In: Shopen, Timothy, (ed), *Language typology and syntactic description*. Cambridge: Cambridge University Press, 276-324.

1.3 Mood operator and sentence radical:

Stenius 1967[4]: Speech acts result as combination of two parts:

- Sentence radical: Proposition,
  a **semantic object** to be dealt with in compositional semantics.
- Sentence mood operator: a function that takes a proposition, yields a **speech act**, a move in a language game, to be treated in pragmatics.

Examples:

- *Ann will come.* ASSERT('Ann will come')
- *Will Ann come?* QUEST('Ann will come')
- *Ann, come!* DIRECT('Ann will come')

… and also:

- *Who will come?* QUEST('x will come'), a special sentence radical

Possible analysis of embedded questions as involving sentence radicals:

- *Ed knows / wonders who will come.* 'Ed knows / wonders' + 'x will come'

Requires to distinguish between assertion radicals and question radicals:

- *Ed knows that Ann will come / whether Ann will come.*
- *Ed wonders *that Ann will come / whether Ann will come.*

[4] Stenius, E. 1967. Mood and language game. *Synthese* 17: 254-274.

2 Types of questions

2.1 Polarity questions (yes/no questions)

Ask whether a propositional sentence radical holds or does not hold:

- *Did Ann come to the party?*

Typical answer by response particles (can also be used after assertions).

- S_1: *Ann came to the party. / Did Ann come to the party?*
  S_2: *Yes. / No.*

Here: marking of polarity questions by syntactic structure

Other marking of polarity questions (cf. short survey in König & Siemund 2007):

- Question particles: Japanese, Swahili, Georgian.

  *kono hon wa omishiroi desu **ka*** — 'Is this book interesting?'
  ***je**, alikwenda shuleni?* — 'Did he/she go to school?'
  *čai **xom** ginda?* — 'Do you want tea?'

- Verbal morphology: West Greenlandic.

  Iga-va? cook-INTER.3SG
  Iga-vok. cook-DECL.3SG
  Iga-git. cook-IMP.2SG

- Prosody, typically final rise, e.g. "declarative questions" (Gunlogson 2002):[5]

  Ann came to the party? ↑

- No marking, i.e. no difference to assertions: Yeli dnye (isolate, Papuan)

[5] Gunlogson, Christine. 2002. *Declarative questions*. SALT 12. Ithaca, NY: Cornell University, 124-134.

2.2 Constituent questions

Ask for the values of a sentence radical with partially unspecified propositions, unspecified arguments and adjunct, also in certain sub-constituents:

- *Who did Ed see?* *Who saw Beth?*
- *When did Beth come?* *Where did Beth go?* *How did Beth do this?*
- [*Whose book*] *did you read?* *What do you believe* [*Beth will win* _]*?*

Not for extra-propositional meanings:

- *<u>Luckily</u>, Beth came to the party.* – questioning *luckily* impossible.

Questioning verbal predicates requires higher-order verbs in English, pro-verbs e.g. in Oceanic languages, e.g. Daakie (Ambrym, Vanuatu):

- *Ko-m maha okele?*
  2SG-RE do.what here 'What are you doing here?'

Marking by wh-movement (English) or wh-in-situ (e.g., Chinese):

- *Hufei mǎi-le shénme?*
  Hufei buy-PERF what 'What did Hufei buy?'

Multiple constituent questions: matching (pair-list); multiple movement in Slavic

- *Who insulted whom?* *Who insulted whom when?*

Wh-in-situ questions in English (echo or exam questions):

- *Napoleon invaded Russia when?* ↑ *Which French emperor invaded Russia when?* ↑

Answers to wh-questions by term answers, or larger constituents with focus marking; notion of **congruent** answers.

- Focus marking in English:

  S_1: *Who saw Beth?*
  S_2: *Ed. / ED saw Beth.*

  S_1: *Who did Ed see?*
  Beth. / Ed saw BETH.

- Syntactic movement in focus position: Hungarian

  Anna fel-hívta Emil-t. ‘Anna called Emil.’

  S_1: *Anna kit hívta fel?* ‘Who did Anna call?’
  S_2: *Emil-t. / Anna Emil-t hívta fel.* ‘Emil. / Anna called Emil.’

2.3 Alternative questions

Ask for the values of a sentence radical that denotes more than one proposition, indicated by a disjunction.

- *Did Ed see ANN↑ , or did Ed see BETH↓?*
  Did Ed see ANN↑ or BETH↓?
- *DID↑ Ed see Ann, or did he NOT↓ see Ann?*
  DID↑ Ed see Ann, or NOT↓?
  Did Ed see ANN↑, or NOT↓?

Formally similar to polarity question, but answer pattern similar to constituent question:

- S_1: *Did Ed see ANN↑ or BETH↓?*
  S_2: **Yes. / *No. / Ann. / Ed saw ANN↓.*

But no wh-movement of disjunctive constituent (lack of wh-marker):

- *Who did Ed see (ANN↑ or BETH↓)?*
  **ANN↑ or BETH↓ did Ed see?*

Disjunction can be interpreted proposition-internal, leading to polarity question:

- S_1: *Did Ed see Ann or Beth↑?*
  S_2: *No. / Yes (, he saw Ann). / *Ann.*

Specialized disjunction, e.g. in Finnish:

- *Haluat-**ko** sinä teetä **vai** kahvia?* *‘Do you want tea, or coffee?’*
  *Haluat-ko sinä teetä **tai** kahvia?* *‘Do you want tea or coffee (a hot beverage)?*

2.4 Root questions vs. embedded questions

Polarity questions (English, German)

- ***Did*** *Ann come to the party?*
  *Ed knows *did Ann come to the party /* ***whether/if*** *Ann came to the party.*
  Ed wonders % did Ann come to the party / whether/if Ann came to the party.
- ***Ist*** *Anna zur Party gekommen?* — Root clause: V movement
  Ed weiß / fragt sich, ***ob*** *Anna zur Party gekommen* ***ist****.* — Dependent clause: V final

Wh questions:

- *Who came to the party?*
  Ed knows who came to the party.
- *Wer* ***ist*** *zur Party gekommen?*
  Ed weiß, wer zur Party gekommen ***ist****.*

Alternative questions:

- ***Did*** *Ann or Beth come to the party?*
  Ed knows ***whether*** */* ***if*** *Ann or Beth came to the party.*
- ***Ist*** *Anna oder Betty zur Party gekommen?*
  Ed weiß, ***ob*** *Anna oder Betty zur Party gekommen* ***ist****.*

Observe:

- Embedded questions need a complementizer,
  wh-element can satisfy the complementizer requirement.

3 Modeling question meanings

3.1 Investigating the semantics of questions

Importance of congruent **answers** to questions:

- Congruent Answers “fit” to their question;
  different questions have different possible congruent answers.
  (H. Paul 1880[6], von Stechow 1990[7])
- Meaning of answers is well-understood.
- Meaning of possible congruent answers leads to a meaning of questions.

Importance of **embedded** questions:

- Root questions are speech acts, often considered outside of semantics proper,
  e.g. *Who came to the party?*
- Questions can be embedded, contributing to the meaning of a proposition,
  e.g. *Ed knows who came to the party?*
- Speech acts can be partitioned into sentence mood operator + sentence radical,
  sentence radical is identical to the “embedded” question.
- Consequently, semantics should first concentrate on embedded questions,
  meaning of such questions should be input to a pragmatic theory of questions.

[6] Paul, Hermann. 1880. *Prinzipien der Sprachgeschichte*. Leipzig: Niemeyer. English: 1891. *Principles of the history of language*. Translated from the second edition of the original by H. A. Strong. London: Longmans, Green, and Co.

[7] von Stechow, Arnim. 1990. Focusing and backgrounding operators. In: Abraham, Werner, (ed), *Discourse particles.* Amsterdam: John Benjamins, 37-84.

3.2 A simple framework for semantic representation

Building blocks (semantic types):

- t truth values: {0,1}, false and true
- e entities: A, the domain of individuals variables: x, y, ...
- s indices: I, the set of possible worlds / times variable: i, i′, …

Meanings (intensions) of basic expressions as functions from indices:

- propositions: I→{0,1} st ⟦*it is raining*⟧: λi[it is raining in i]
- names: I→E se ⟦*Ann*⟧: λi[the person called *Ann* in i]
- properties: I→[E→{0,1}] set ⟦*come*⟧: λiλx[x comes in i]
- relations-in-intension I→[E→[E→{0,1}]] seet ⟦*see*⟧: λiλyλx[x sees y in i]

where λX[... X …] stands for a function from X - objects into [… X …] - objects.

Compositional derivation of meanings of complex expressions:

- ⟦*Ann comes*⟧ = λi[⟦*comes*⟧(i)(⟦*Ann*⟧(i))]
  = λi[λiλx[x comes in i](i)(λi[the person called *Ann* in i](i)]
  = λi[λx[x comes in i]([the person called *Ann* in i])
  = λi[the person called *Ann* in i comes in i]
- Can be represented as set: {i | the person called Ann in i comes in i}

For context-dependent expressions: Characters, function from context indices c:

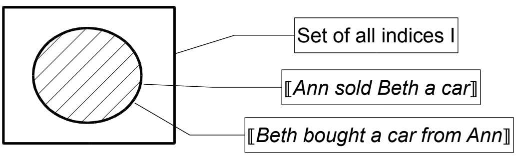
- ⟦*I will come*⟧ = λcλi[c < i ∧ speaker(c) comes in i]

3.3 The nature of semantic representations

The same meaning can be expressed in different ways:

- ⟦*Ann saw Beth*⟧ = ⟦*Beth was seen by Ann*⟧
- ⟦*Ann sold Beth a car*⟧ = ⟦*Beth bought a car from Ann*⟧
- ⟦*Ann came or Beth came*⟧ = ⟦*Beth came or Ann came*⟧
- ⟦*two plus two is four*⟧ = ⟦*the square root of 144 is 12*⟧

Corollary: Given a particular meaning, we do not know how it was expressed.



Consequence: Expressions with the same intensions lead to

- ⟦*Ed knows that Ann sold Beth a car*⟧ = ⟦*Ed knows that Beth bought a car from Ann*⟧
- ⟦*Ed knows that 2 + 2 = 4*⟧ = ⟦*Ed knows that √144 = 12*⟧ (!)

There are inexpressible meanings:

- E.g., a specific random assignment of natural numbers 1, 2, 3, …
  to categories A and B cannot be expressed by a finite sentence.

4 Functional Question Theories

4.1 Basic idea

We have seen that (constituent) question radicals denote “open” propositions

- *Who knows Beth?* λi[__ knows Beth in i]
- *Who does Ed know?* λi[Ed knows __ in i]
- *Who knows whom?* λi[__ knows __ in i]

We can represent the gaps by lambda-bound variables:

- *Who knows Beth?* λxλi[x knows Beth in i]
- *Who does Ed know?* λyλi[Ed knows y in i]
- *Who knows whom?* λxλyλi[x knows y in i]

We can represent the contribution of the wh-element by a restriction:

- *Who does Ed know?* λy∈person λi[Ed knows y in i]
- *What does Ed know?* λy∈thing∪proposition λi[Ed knows y in i]
- *Which book does Ed know?* λy∈book λi[Ed knows y in i]

Cf. Ajdukiewicz 1927, Cohen 1927, Jespersen 1940 (variables), Hull 1975, Belnap & Steel 1976, Hausser & Zaefferer 1979, Hausser 1983, Ginzburg 1992...

Structured propositions (von Stechow 1990):

- *Who does Ed know?* 〈person, λy[Ed knows y in i]〉

4.2 Q/A congruence in simple constituent questions

Term answers:

- The meaning of the question is applied to the meaning of the term answer
- S_1: ⟦*who does Ed know*⟧ = λy∈person λi[Ed knows y(i) in i]
  S_2: ⟦*Beth*⟧ = λi[the person called *Beth* in i]
  Interpretation: λy∈person λi[Ed knows y in i] (λi[the person called *Beth* in i])
  = λi[Ed knows the person called *Beth* in i in i]
- S_2: ⟦*“War and Peace”*⟧ = λi[the novel *War and Peace*]
  Interpretation: Meaning of question not defined for the meaning of the answer.

Full answers:

- Focus in the answer generates a background-focus structure
- The question meaning is a subset of the background of the answer
- The meaning of the question is applied to the meaning of the focus of the answer
- S_2: ⟦*Ed knows BETH$_F$*⟧ = 〈Beth, λy λi[Ed knows y in i]〉
  condition λy: person(y) λi[Ed knows y(i) in i] ⊆ λy λi[Ed knows y in i]〉 is satisfied, interpretation as above.
- S_2: ⟦*ED$_F$ knows Beth*⟧ = 〈Ed, λx λi[x knows Beth in i]〉
  condition λy∈person λi[Ed knows y(i) in i] ⊆ λx λi[x knows Beth in i]〉 not satisfied
- S_2: ⟦*Ed knows “WAR AND PEACE”$_F$*⟧ = 〈λi[the novel W&P], λyλi[Ed knows y in i]〉
  condition satisfied, but meaning of question not defined for meaning of answer.

4.3 Compositional derivation of questions and answers

Derivation of question meanings in wh-movement languages:

- Movement of wh-constituent leaves a trace
  $[_{CP}$ *who* $_1[_{IP}$ *Ed knows* $t_1]]$, $[_{ForceP}$ *who* $_1[$ *does* $_2[_{IP}$ *Ed* t_2 *know* $t_1]]]$
  $[_{CP}$ *who* $_1[t_1$ *knows Beth*$]]$, $[_{ForceP}$ *who* $_1[_{IP}$ *Ed knows* $t_1]]$
- Constituent containing a trace gets a functional interpretation (Heim & Kratzer 1998)
  $[\![\ _1[\textit{Ed knows}\ t_1]]\!] = \lambda x_1\ \lambda i[\text{Ed knows } x_1 \text{ in } i]$
- wh-constituent supplies the restriction:
  $[\![[_{CP}\ \textit{who}\ _1[_{IP}\ \textit{Ed knows}\ t_1]]]\!] = \lambda x_1{\in}\text{person}\ \lambda i[\text{Ed knows } x_1 \text{ in } i]$

Derivation of questions in wh-in-situ languages by LF movement:

- Assume wh-movement on level of logical form
  Ed zhīdào shúi $\rightarrow$ *shúi* $_1[$*Ed zhīào* $t_1]$

Multiple wh-questions: LF movement in English (surface movement in Slavic, Romanian):

- $[_{CP}$ *who* $_1[_{IP}\ t_1$ *knows what*$]] \rightarrow [_{CP}$ *who what* $_{1,2}[_{IP}\ t_1$ *knows* $t_2]]$
  $[\![[_{CP}\ \textit{who}\ _1[\ \textit{what}\ _2[_{IP}\ t_1\ \textit{knows}\ t_2]]]]\!] = \lambda x{\in}\text{person}\ \lambda y{\in}\text{thing}\ \lambda i[\text{x knows y in i}]$
- Capturing pair-list interpretation in matching questions: absorption of wh to function:[8]
  $[\![[_{CP}\ \textit{who what}\ _{1,2}[_{IP}\ t_1\ \textit{knows}\ t_2]]]\!] = \lambda f{\in}[\text{person}{\rightarrow}\text{things}]\ \lambda i\ \forall x{\in}\text{DOM}(f)[\text{x knows f(x) in i}]$

---

[8] Higginbotham, James & Robert May. 1981. Questions, quantifiers, and crossing. *The Linguistic Review* 1: 41-80, Krifka, Manfred. 2001. For a structured account of questions and answers. In: Féry, Caroline & Wolfgang Sternefeld, (eds), *Audiatur vox sapientiae. A Festschrift for Achim von Stechow*. Berlin: Akademie-Verlag, 287-319.

4.4 Polarity questions

Functional theory can assume a function for proposition modifiers:

- $[\![[_{CP}\ \textit{whether}\ [\textit{Beth came to the party}]]]\!] = \lambda f{\in}\{\lambda p[p], \lambda p\lambda i\neg p(i)\}\ f(\lambda i[\text{Beth came in i}])$
  $[\![[_{ForceP}\ \textit{did}\ _1[\textit{Beth}\ t_1\ \textit{come to the party}]]]\!]$
- $[\![\textit{yes}]\!] = \lambda p[p]$
  $[\![\textit{no}]\!] = \lambda p\lambda i\neg p(i)$
- Answer *no*: $\lambda f{\in}\{\lambda p[p], \lambda p\lambda i\neg p(i)\}\ f(\lambda i[\text{Beth came in i}])\ (\lambda p\lambda i\neg p(i))$
  $= \lambda p\lambda i\neg p(i)(\lambda i[\text{Beth came in i}])$
  $= \lambda i\ \neg[\text{Beth came in i}]$

Another representation (cf. Krifka 2001):

- $\lambda p{\in}\{\lambda i[\text{Beth came in i}], \lambda i\ \neg[\text{Beth came in i}]\}\ [p]$
- Answer $[\![\textit{Beth didn't come to the party}]\!] = \lambda i\ \neg[\text{Beth came in i}]$
  $\lambda p{\in}\{\lambda i[\text{Beth came in i}], \lambda i\ \neg[\text{Beth came in i}]\}\ [p]\ (\lambda i\ \neg[\text{Beth came in i}])$
  $= \lambda i\ \neg[\text{Beth came in i}]$

Notice for both representations: Rules for Q / A congruence are satisfied.

4.5 Alternative questions

Assumption: LF movement

- ⟦[$_{CP}$ *Ann or Beth* $_1$[*did* [t_1 *come to the party*]]]⟧
  = λx∈{Ann, Beth} λi[x came to the party]

Problem:

- no wh-feature that triggers this type of movement
- languages do not have overt movement in this case.

4.6 Embedded wh-questions

Embedding of *that*-clause (proposition):

- ⟦[*Ed knows* [$_{CP}$ *that Ann came to the party*]]⟧ = λi[Ed knows λi[Ann came in i] in i]

Question-embedding *know* traced back to proposition-embedding *know*:

- $\text{know}_{i*}(Q)(Ed) \Leftrightarrow \forall x{\in}DOM(Q)\ [Q(x)(i^*) \rightarrow \text{know}_{i*}(Q(x))(Ed)]$
- $\text{know}_{i*}(\lambda x{\in}\text{person}\ \lambda i[x \text{ came in } i])(Ed)$
  $\Leftrightarrow \forall x{\in}\text{person}\ [x \text{ came in } i^* \rightarrow \text{know}_{i*}(\lambda i[x \text{ came in } i])]$

Factivity of question-embedding verbs, cf. Karttunen 1997[9]

- *Ed told Bill who came to the party.* factive
  Ed told Bill that Ann came to the party. not factive
- choice of factive *know* over non-factive *believe* due to presupposition maximization:
  *Ed knows / *believes who came to the party.*

Irreducible cases of question embedding, e.g. *wonder, ask*

- *Ed wonders who came to the party. / *that Ann came to the party.*
- $\text{wonder}_{i*}(Q)(Ed)$: Ed wants to know in i^* for which $x{\in}DEF(Q)$ it holds that $Q(i^*)(x)$

[9] Karttunen, Lauri. 1977. Syntax and semantics of questions. *Linguistics and Philosophy* 1: 3-44.
Cf. also Spector, Benjamin & Paul Égré. 2015. A uniform semantics for embedded interrogatives: An answer, not necessarily the answer. *Synthese* 192: 1729-1784.,
Cf. also Schwabe, Kerstin & Robert Fittler. 2009. Semantic characterizations of German question-embedding predicates. In Peter Bosch, e.a. (eds.), *Lectures Notes in Artificial Intelligence* 5422, 229-241. Berlin: Springer.

4.7 Further observations about embedding predicates

- Restriction of question is not part of the scope of the predicate:
  Ed knows which woman came to the party.
  Compatible with: Ed knows that Ann came to the party, and she in fact came, but Ed does not know that Ann is a women.
- Presupposition of singular questions not represented:
  Ed knows which woman came to the party.
  ⇒ There is exactly one woman that came to the party. – does not follow from repr.
- False belief is not excluded:
  Ed knows which women came to the party.
  compatible with: Ed wrongly believes that Daniela came, too.

  Exclusion by strengthened reading:
  $\text{know}_{i*}(Q)(Ed) \Leftrightarrow \forall x{\in}DOM(Q)\ [Q(x)(i^*) \leftrightarrow \text{know}_{i*}(Q(x))(Ed)]$, no false beliefs
- Weak readings ("mention some interpretation"):
  Ed knows where one can buy English newspapers in Barcelona., not predicted weakened reading:
  $\text{know}_{i*}(Q)(Ed) \Leftrightarrow \exists x{\in}DOM(Q)\ [Q(x)(i^*) \rightarrow \text{know}_{i*}(Q(x))(Ed)]$
- Explicit quantification over questions (Berman 1989[10], Lahiri 2001).
  Ed knows for the most part who came to the party.
  $\text{most}\ x{\in}DOM(Q)\ [\text{know}_{i*}(Q(x))(Ed)]$

[10] Berman, Stephen. 1989. An analysis of quantificational variability in indirect questions. In: Bach, E. e.a. (eds), *Papers on Quantification*. University of Massachusetts at Amherst,

4.8 A new propsal

Application of question meaning to the sum of entities to which the question applies in the world of evaluation.

- *Ed knows which women came to the party*.
- Sum formation: $\sigma x\ P(x)$ = the sum of all x such that P(x),
- Maximum: $\iota x\ P(x) = \sigma x\ [P(x)]$, provided that $P(\sigma x\ P(x))$, else undefined
  e.g. ιx[x are women in i] = σx[x are women in i] = the sum of all women in i
  ιx[x is a woman in i] = the woman in i, provided that there is exactly one
- $\text{know}_{i*}(Q)(Ed) \Leftrightarrow \text{know}_{i*}(Q(\iota x[Q(x)(i^*)]))(Ed)$
- *Ed knows which woman came to the party*
  $\text{know}_{i*}(\lambda x{\in}\text{woman}\ \lambda i[\text{x came in i}])(Ed)$
  $\Leftrightarrow \text{know}_{i*}(\lambda x{\in}\text{woman}\ \lambda i[\text{x came in i}](\iota x{\in}\text{women}[\text{x came in } i^*]))(Ed)$
  $\Leftrightarrow \text{know}_{i*}(\lambda i[\iota x{\in}\text{woman}[\text{x came in } i^*] \text{ came in } i^*])(Ed)$
  'Ed knows that the woman that in fact came, came.'
  presupposes that exactly one women came.
- *Ed knows which women came to the party.*
  $\text{know}_{i*}(\lambda x{\in}\text{women}\ \lambda i[\text{x came in i}])(Ed)$
  $\Leftrightarrow \text{know}_{i*}(\lambda i[\iota x{\in}\text{women}[\text{x came in } i^*] \text{ came in } i^*])(Ed)$
  'Ed knows that the women that in fact came, came.',
  presupposed that there were women that came.
- *Ed knows for the most part, which women came*: reference to part of the women.

4.9 Conjoined wh-question

Problem of different types:

- *Ed knows who came to the party*
  and whether the party was a success.

Explain by wide-scope coordination:

- *Ed knows who... and knows whether...*
- ⟦*who came to the party*⟧ = λx∈PERSON λi[x came to the party]

  ⟦*whether the party was a success*⟧ = λf∈{λpp, λp¬p} f(λi[the party was a success in i])

  ⟦*who came to the party and whether it was a success*⟧
  = λi λR λx[R(⟦*who came to the party*⟧)(x) ∧ R([⟦*whether it was a success*⟧)(x)]

  ⟦*knows* [*who came to the party and whether it was a success*]⟧
  = λi[⟦*who came to the party and whether it was a success*⟧(i)(⟦*know*⟧(i))
  = λiλx[⟦*know*⟧(i)(⟦*who came to the party*⟧)(x)
  ∧ ⟦*know*⟧(i)⟦*whether it was a success*⟧)(x)]

Cf. other cases of coordination of semantically unlike categories:

- *Ed likes* [[*the sun*] *and* [*swimming in the sea*]].

5 The Proposition Set Approach

5.1 Basic idea

Meaning of a question: set of propositions that are its possible congruent answers

- ⟦*who knows Beth*⟧ = {p | ∃x[person(x) ∧ p = λi[x knows Beth in i]]}
- ⟦*who does Ed know*⟧ = {p | ∃x[person(x) ∧ p = λi[Ed knows y in i]]}
- ⟦*who knows whom*⟧ = {p | ∃x∃y[person(x) ∧ person(y) ∧ p = λi[x knows y in i]]}

Proposition set meaning: Hamblin 1958, 1973[11]

5.2 Functional question meanings compared to proposition sets:

- ⟦*who knows Beth*⟧$_{functional}$ = λx∈person λi[x knows Beth in i]

  ⟦*who knows Beth*⟧$_{propset}$ = {p | ∃x[p = ⟦*who knows Beth*⟧$_{functional}$(x)]]}
- In general: If F is a functional question meaning,
  then {p | ∃x_1...x_n [p = F(x_1)...(x_n)]} is the corresponding proposition set meaning
- It does not work vice versa, functions cannot be recovered from proposition sets
- Difference function restriction (wh-constituent) and body of questions
  cannot be reproduced in proposition set approach
- Hence: Functional question meaning is richer / more expressive,
  theoretical issue: Do we need the additional expressiveness of functional theory?

---

[11] Hamblin, C. L. 1958. Questions. *The Australasian Journal of Philosophy* 36: 159-168.
Hamblin, C.L. 1973. Questions in Montague English. *Foundations of Language* 10: 41-53.

5.3 Q/A congruence in proposition set theory

Proposal (von Stechow 1990, Rooth 1992):[12]

- Focus in answer creates a set of alternative propositions:
  ⟦*Ed knows BETH*$_F$⟧^{o} = λi[Ed knows Beth in i] ordinary meaning
  ⟦*Ed knows BETH*$_F$⟧^{f} = {p | ∃y[p = λi[Ed knows y in i]} focus meaning
- Q / A are congruent iff ⟦Q⟧ ⊆ ⟦A⟧^{f} and ⟦A⟧^{o} ∈ ⟦Q⟧
  ⟦*who Ed knows*⟧ = {p | ∃y[person(y) ∧ p = λi[Ed knows y in i]]}
  ⊆ ⟦*Ed knows BETH*$_F$⟧^{f} = {p | ∃y[p = λi[Ed knows y in i]]}
- Not a congruent answer:
  ED$_F$ *knows Beth*, as ⟦Q⟧ ⊈ ⟦A⟧^{f} = {p | ∃x[p = λi[x knows Beth in i]}
  Ed knows "War and Peace" as ⟦A⟧^{o} = λi[Ed knows W&P in i] ∉ ⟦Q⟧

Term answers as instances of ellipsis of given expressions:

- S_1: *Who does Ed know?*
  S_2: ~~*Ed knows*~~ *BETH*$_F$.
- Cf. case requirements:
  S_2: ~~*Ed knows*~~ *HER*$_F$. / **SHE*$_F$.

[12] Rooth, Mats. 1992. A theory of focus interpretation. *Natural Language Semantics* 1: 75-116.

5.4 Multiple questions

Representation of multiple questions:

- ⟦*who knows who*⟧ = {p | ∃x∃y[person(x) ∧ person(y) ∧ p = λi[x knows y in i]]}
- ⟦*ED*$_F$ *knows BETH*$_F$⟧^{o} = λi[Ed knows Beth in i]
  ⟦*ED*$_F$ *knows BETH*$_F$⟧^{f} = {p | ∃x∃y[p = λi[x knows y in i]}
- Q / A congruence is established

A problem with congruence:

- Q′ = ⟦*who knows Beth*⟧ = {p | ∃x∈person[x knows Beth]}
  would also lead to a congruent pair Q′ / A with *ED*$_f$ *knows BETH*$_f$
- We have to assume a pragmatic tendency for restrictive focus marking
  cf. Schwarzschild 1999:[13]:
  When answering a question, use as little focus marking as possible
  to achieve congruence ⟦Q⟧ ⊆ ⟦A⟧^{f}

[13] Schwarzschild, Roger. 1999. GIVENness, AvoidF and other constraints on the placement of accent. *Natural Language Semantics* 7: 141-177.

5.5 Compositional derivation of constituent questions

Pointwise construction of meanings / alternatives (Alternative Semantics).

Interpretation of focus in answers:

- $\llbracket ED_F \rrbracket^o$ = Ed,
  $\llbracket ED_F \rrbracket^f$ = A, the set of individuals, or salient alternatives to Ed
  $\llbracket \alpha \rrbracket^f = \{\llbracket \alpha \rrbracket^o\}$, if α is not focused
  if $\llbracket [\alpha\ \beta] \rrbracket^o = C(\llbracket \alpha \rrbracket^o, \llbracket \beta \rrbracket^o)$, then $\llbracket [\alpha\ \beta] \rrbracket^f = \{C(X,Y) \mid X \in \llbracket \alpha \rrbracket^f \wedge Y \in \llbracket \beta \rrbracket^f\}$
- $\llbracket \textit{Beth} \rrbracket^f = \{\llbracket \textit{Beth} \rrbracket^o\}$
  $\llbracket \textit{knows} \rrbracket^f = \{\lambda i \lambda y \lambda x[x \text{ knows } y \text{ in } i]\}$
  $\llbracket [\textit{knows Beth} \rrbracket^f = \{\lambda i \lambda x[x \text{ knows } y \text{ in } i] \mid y \in \{\llbracket \textit{Beth} \rrbracket^o\} = \{\lambda i \lambda x[x \text{ knows Beth in } i]$
  $\llbracket \textit{ED} \rrbracket^f = A$
  $\llbracket \textit{ED}_F \textit{ knows Beth} \rrbracket^f = \{\lambda i[x \text{ knows Beth in } i] \mid x \in A\}$

Interpretation of wh-words in questions

- wh-words only have alternative meanings
- for the clause type of questions: ordinary meaning = alternative meaning
- $\llbracket \textit{who} \rrbracket^f$ = person
  $\llbracket \textit{Ed knows who} \rrbracket^f = \{\lambda i[\text{Ed knows } x \text{ in } i] \mid x \in \text{person}\}$
  $\llbracket [_Q \textit{ who does Ed knows}] \rrbracket^o = \llbracket \textit{Ed knows who} \rrbracket^f$

5.6 Consequences for movement

Difference of function theory / proposition set theory:

- no wh-movement necessary, hence well-suited for wh-in-situ languages
- Alternative semantics does not predict wh-island effects,
  but see von Stechow 1996[14] for island effects even in wh-in-situ.
  S_1: *Ann likes the author that wrote which novel?*
  S_2: **War and Peace. / The author who wrote War & Peace.*

Hybrid account: cf. Krifka 2006[15]

- Pied-piping of wh-phrase on LF:
  [[*the author of which novel*] $_1$[*Ann likes* t_1]]
- Pied-piping of focus phrase containing a wh-element:
  [[*the author who wrote WAR AND PEACE*$_F$] $_1$[*Ann likes* t_1]]
- Island restriction for movement of focus phrase:
  but focus can be arbitrarily deeply embedded in focus phrase
- Focus: $\lambda i\ \iota x[\text{author}_i(x) \wedge x \text{ wrote W\&P in } i]$
  Focus alternatives: $\{\lambda i\ \iota x[\text{author}_i(x) \wedge x \text{ wrote } x \text{ in } i] \mid \text{novel}(x)\}$
  Background: $\lambda x \lambda i[\text{Ann likes } x \text{ in } i]$

[14] von Stechow, Arnim. 1996. Against LF pied-piping. *Natural Language Semantics* 4: 57-110.
[15] Krifka, Manfred. 2006. Association with focus phrases. In: Molnár, Valerie & Susanne Winkler, (eds), *The architecture of focus*. Berlin: Mouton de Gruyter, 105-136.

5.7 Polarity questions

Meaning: Set of proposition and its alternatives

- ⟦*Ed knows Beth*⟧^{f} = {λi[Ed knows Beth in i]}
  ⟦*whether*⟧^{f} = {λp[p], λp[¬p]}
  ⟦*whether Ed knows Beth*⟧ = {λi[Ed knows Beth in i], λi¬[Ed knows Beth in i]}
- Same for root questions:
  ⟦*does*⟧^{f} = {λp[p], λp[¬p]}
  ⟦*does Ed know Beth*⟧^{f} = {λi[Ed knows Beth in i], λi¬[Ed knows Beth in i]}

Congruent answers:

- Ordinary meaning of answer:
  ⟦*Ed knows Beth.*⟧^{o} = λi[Ed knows Beth in i]
- Possible alternatives by verum focus:
  ⟦*Ed DOES know Beth*⟧^{f} = {λi[Ed knows Beth in i], λi¬[Ed knows Beth in i]}
- Answers *yes / no* would have to be explained by other means,
  e.g. propositional anaphora (see second day).

5.8 Alternative questions

Alternative questions introduce alternatives:

- *Does Ed know ANN↑ or BETH↓?*
  = Does Ed know ANN↑ or ~~does Ed know~~ BETH↓?
- Question-forming disjunction:
  ⟦*or*⟧ = λp λq {p, q}
- ⟦*does Ed know ANN↑ or ~~does Ed know~~ BETH↓*⟧
  = {⟦*Ed knows Ann*⟧^{o} , ⟦*Ed knows Beth*⟧^{o}}

Answer with focus:

- ⟦*Ed knows ANN*$_F$⟧^{o} = λi[Ed knows Ann in i]
  ⟦*Ed knows ANN*$_F$⟧^{f} = {λi[Ed knows x in i] | x∈A}
- Congruent answer, as ⟦Q⟧ ⊆ ⟦A⟧^{f} and ⟦A⟧^{o} ∈ ⟦Q⟧

5.9 Embedded questions

Similar to functional theory, adapted for proposition sets:

- $know_i(Q)(Ed) \Leftrightarrow \forall p\, [p(i) \rightarrow know_i(p)(Ed)]$
- $know_i(\lambda x\text{: person } \lambda i[x \text{ came in } i])(Ed) \Leftrightarrow$
  $\forall x{\in}person\, [x \text{ came in } i \rightarrow know_i(\lambda i[x \text{ came in } i])]$

As all questions are sets of propositions:

- Straightforward explanation of conjunction, but as set union:
  ⟦*who came to the party and whether it was a success*⟧
  = ⟦*who came to the party*⟧ ∪ ⟦*whether it was a success*⟧
- But type-theoretic problem appears with conjunction of question and proposition:
  Ed knows who came to the party and that it was a success.

6 The partitional approach

6.1 Basic idea

A variant of the proposition set approach:

- Set of proposition that forms a partition of the set of all propositions

Derivation as equivalence relation between indices:

- ⟦*who knows Beth*⟧
  = λjλi[λx∈person [x knows Beth in i] = λx∈person [x knows Beth in j]]
  holds between indices i, j iff Beth is known by the same persons in i and j
- ⟦*who knows who*⟧
  = λjλi[λy∈person λx∈person [x knows y in i] = λy∈person λx∈person [x knows y in j]]
  holds between indices i,j iff the persons x that know the persons y are the same.
- ⟦*whether Ed knows Beth*⟧
  = λjλi[[Ed knows Beth in i] = [Ed knows Beth in j]]
  hold between i and j iff the truth value of 'Ed knows Beth' is the same.

Equivalence relations define partitions:

- If r an equivalence relation for indices,
  then $\{p \mid \forall i,j[p(i) \wedge p(j) \leftrightarrow r(i)(j)]\}$ a partition all indices

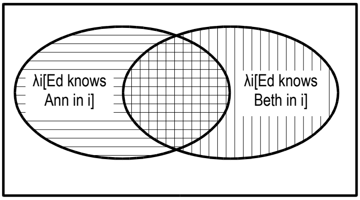
Proposed by Higginbotham & May 1981, Groenendijk & Stokhof 1982, 1984[16]

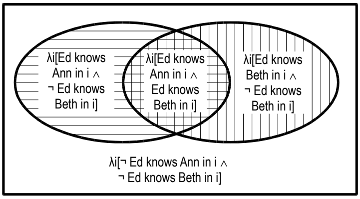
[16] Groenendijk, Jeroen & Martin Stokhof. 1984. Studies on the semantics of questions and the pragmatics of answers. Doctoral Dissertation. University of Amsterdam.

6.2 Comparison with partition sets and functional interpretation

Comparison proposition set / partition
for *Ed knows which woman*, with Ann, Beth, if Ann, Beth are the only women:

- proposition set: $\{p \mid \exists y \in woman[p = \lambda i[\text{Ed knows } y \text{ in } i]\}$
- partition: $\{p \mid \forall j \forall i[p(i) \wedge p(j) \leftrightarrow \lambda y \in woman[\text{Ed knows } y \text{ in } i] = \lambda y[\text{Ed knows } y \text{ in } j]]$,
  assumes that *Ed knows no woman, Ed knows Ann and Beth* are congruent answers





- From proposition sets to partitions by intersecting all the propositions

Comparison with functional interpretation:

- functional: $\lambda y \in woman\ \lambda i[\text{Ed knows } y \text{ in } i]$
- Derivation of partitional interpretation from functions f, simplified: $\lambda j \lambda i[f(i) = f(j)]$,
  but derivation of functional readings from partitions is not possible

6.3 Answers in the partitional approach

Partial and total answers

- Question: *Which woman does Ed know?,* assume Ed knows Ann and Beth.
- Two true answers in functional approach and propositional approach:
  (a) *Ed knows Ann,* (b) *Ed knows Beth*

  Semantics with built-in partial answers

  proper answer *Ed knows Ann and ~~Ed knows~~ Beth* due to a pragmatic rule:
  Give all true answers (when relevant)
- Only one true answer in partitional approach: (c) *Ed knows Ann and Beth.*

  Semantics with built-in total answers

  Partial answers due to a special answerhood relation:
  a proposition that excludes at least one cell of the partition.
- Evidence for partial answers:
  Ed knows where they sell English newspapers in Barcelona.

Focus in answers

- No proposal on the market
- Intersecting all propositions in $[\![$*Ed knows BETH*$_F]\!]^f$ does not help,
  as this relates to the more specific question *What/Who does Ed know?*
- Possible only if the restriction of the question (to women) is taken over
  as restriction of the alternatives of the focus.

6.4 Embedded questions

Embedded questions under verbs like *know*:

- (a) *Ed knows which woman came to the party*
- ⟦*which woman came to the party*⟧
  $= \lambda j\lambda i[\lambda x{\in}\text{woman}[x \text{ came in } i] = \lambda x{\in}\text{woman}[x \text{ came in } j]]$
- question-embedding *know*:
  $\text{know}_{i*}(Q)(\text{Ed}) = \text{know}_{i*}(Q(i*))(\text{Ed})$ – embeds "extension" of question
- $\text{know}(\lambda j\lambda i[\lambda x{\in}\text{woman}[x \text{ came in } i] = \lambda x{\in}\text{woman}[x \text{ came in } j]])(\text{Ed})$
  $= \text{know}_{i*}(\lambda j\lambda i[\lambda x{\in}\text{woman}[x \text{ came in } i] = \lambda x{\in}\text{woman}[x \text{ came in } j]](i*))(\text{Ed})$ in $i*$
  $= \text{know}_{i*}(\lambda i[\lambda x{\in}\text{woman}[x \text{ came in } i] = \lambda x{\in}\text{woman}[x \text{ came in } i*]])(\text{Ed})$
- If Ann is the only woman that came to the party,
  then the complement has the same meaning as *that Ann came to the party*
- It then follows from (a) that *Ed knows that Ann came to the party.*
- Problem: Wrongly predicts congruent answers like *no woman* ... or *Ann and Beth*...

Embedded questions under verbs like *wonder*:

- *Ed wonders which woman came to the party*
- $\text{wonder}_{i*}(Q)(\text{Ed})$, not reducible – embeds "intension" of question
- meaning: 'Ed is interested in $i*$ what $Q(i*)$ is – i.e. in Q's true answer in $i*$

7 Inquisitive Semantics

Proposal developed by Groenendijk & Roelofesen 2009, Ciardelli e.a. 2013[17]

7.1 Basic idea:

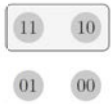
- Meanings in general as relations between indices that is reflexive and symmetric, but not transitive – hence not an equivalence relation as in partition representation
- These relations lead to sets of propositions that may overlap, as with Hamblin.
- But: No type difference between the meaning of declaratives and interrogatives, both represented as sets of sets of indices, called "propositions"
- provided that the sets are downward closed, here: $\downarrow S = \text{pow}(S) - \varnothing$ (?)
- ⟦*Ed met Beth*⟧
  $= \{\downarrow\lambda i[\text{Ed met Beth in } i]\}$ non-inquisitive information state
  ⟦*whether Ed met Beth*⟧
  $= \{\downarrow\lambda i[\text{Ed met Beth in } i], \downarrow\lambda i\neg[\text{Ed knows Beth in } i]\}$ inquisitive issue
  ⟦*whether Ed met ANN or BETH*⟧
  $= \{\downarrow\lambda i[\text{Ed met Ann in } i], \downarrow\lambda i[\text{Ed met Beth in } i],$
  $\downarrow\lambda i\neg[\text{Ed met Ann or Beth in } i]\}$ inquisitive issue
- Notice: Any (old) proposition in the downward closure identifies one maximal cell of an inquisitive issue

[17] Ciardelli, Ivano, Jeroen Groenendijk & Floris Roelofsen. 2013. Inquisitive semantics: a new notion of meaning. *Language and Linguistic Compass* 7: 459-476; see also https://www.illc.uva.nl/inquisitivesemantics/

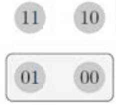
7.2 Formal language of Inquisitive Semantics

Consider example of four worlds:

- P(a) is true in 11, 10, P(b) is true in 11, 01
- $[\![P(a)]\!] = \{\{11, 10\}, \{11\}, \{10\}\}$, represented by $\{11, 10\}$
  $[\![P(b)]\!] = \{\{11, 01\}, \{11\}, \{01\}\}$
- informative, not inquisitive, as it reduces information state



(a) *Pa*



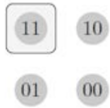
(d) *¬Pa*

Negation:

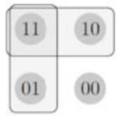
- Negation: complementation (closed under ↓?)
  $[\![\neg P(a)]\!] = \{\{01, 00\}, \{01\}, \{00\}\}$

Conjunction, disjunction, implication

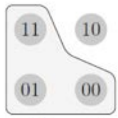
- Conjunction: General intersection
  $[\![P(a) \wedge P(b)]\!] = \{\{11\}\}$
- Disjunction: General union, leads to **inquisitive** meaning
  $[\![P(a) \vee P(b)]\!] = \{\{11, 10\}, \{11\}, \{10\}, \{11, 01\}, \{01\}\}$
- Implication: relative pseudo-complementation
  $[\![P(a) \rightarrow P(b)]\!] = \{\{11, 01, 00\}, \{11, 01\}, \{11, 00\}, \{11\}, \{01\}, \{00\}\}$
- Existential, universal quantifiers: generalized ∧, ∨
  $\forall x P(x) = P(a) \wedge P(b)$, $\exists x P(x) = P(a) \vee P(b)$



(h) *Pa ∧ Pb*



(e) *Pa ∨ Pb*

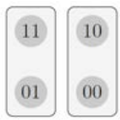


(j) *Pa → Pb*

Question-forming operator:

- $?P(a) = P(a) \vee \neg P(a)$
  $[\![?P(a)]\!] = \{\{11, 10\}, \{11\}, \{10\}, \{01, 00\}, \{01\}, \{00\}\}$
- $[\![?P(b)]\!] = [\![P(b) \vee \neg P(b)]\!]$

(f) *?Pa*



(g) *?Pb*

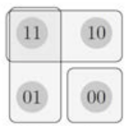
Conjunction of question:

- $[\![?P(a) \wedge ?P(b)]\!] = [\![\forall x\ ?P(x)]\!] = \{\{11\}, \{10\}, \{01\}, \{00\}\}$

Disjunction of questions:

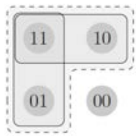
- $[\![?P(a) \vee ?P(b)]\!] = [\![\exists x\ ?P(x)]\!]$
  = the powerset of {11, 10, 01, 00} – Ø, useful?
- Derivation of alternative question
  $?\ \exists x.P(x) = ?\ P(a) \vee P(b)$,
  introduces complement of $P(a) \vee P(b)$

(b) *∀x.?Px*



(a) *?∃x.Px*

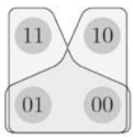
- This appears to represent rising alternative questions:
  Did Ed meet ANN↑, or BETH↑?
- Rise-Fall alternative questions by another operator, leading to a hybrid informative / inquisitive interpretation (?)
  Did Ed meet ANN↑, or BETH↓?



(c) $?_c(Pa \vee Pb)$

Other kinds of questions:

- $P(a) \rightarrow ?P(b)$



(k) *Pa → ?Pb*

Current state of inquisitive semantics:

- Not a theory of questions yet, but a framework to formulate such theories
- No worked-out proposal for compositional derivation of question meanings (but: Work by Andreas Haida)
- No theory of Question / Answer congruence yet.

8 Wrapping up

Achieved: Survey of theories of questions or semantic frameworks

- Functional theories (Ajdukiewicz, ...)
- Proposition set theories (Hamblin, …)
- Partitional theories (Groenendijk & Stokhof, …)
- Inquisitive semantics (Groenendijk, Roelofsen, Ciardelli, …)

We looked into various types of questions:

- Constituent questions
- Polarity questions
- Alternative questions

And uses of questions:

- Truth conditions of clauses containing questions as arguments
- Answers to questions, in particular Q/A congruence and focus marking

Tomorrow:

- Polarity questions,
- in particular: Answers by polarity particles like *yes* and *no*