The pragmatics of questions and answers, Part 2: Partition semantics and decision-theoretic pragmatics

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CMPSCI 585, December 4, 2007

What kind of answer is that? (A cautionary tale)

Example (After Solan and Tiersma 2005:220)

$\mathcal{A}$ I lost my wallet. Do you know where it is?

$\mathcal{B}$ I saw it on the kitchen table earlier.

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- $\mathcal{B}$'s answer is superficially *partial*.
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What pragmatic facts has $\mathcal{B}$ leveraged into a devious answer?

This lecture

1. We'll explore the partition semantics for questions, using it to define some initial pragmatic principles.
2. We'll develop a decision-theoretic perspective on the partition semantics and its pragmatics, with the goal of developing a more general treatment based in information theory.

Question semantics

Groenendijk and Stokhof (1982)

Interrogative denotations partition the information state into equivalence classes based on the extension of the question predicate.

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Answering

- Fully congruent answers identify a single cell.
- Partial answers overlap with more than one cell.
- Over-answers identify a proper subset of one of the cells.

Polar questions

$$[\![\textit{Did Sam laugh?}]\!] =$$

$$\left\{ \{v \in W \mid v \in [\![\textbf{laugh(sam)}]\!] \text{ iff } w \in [\![\textbf{laugh(sam)}]\!]\} \;\middle|\; w \in W \right\}$$

$[\![\textbf{laughed(sam)}]\!]$	$W - [\![\textbf{laughed(sam)}]\!]$

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$[\![\textbf{laughed}(\textbf{sam})]\!]$	$W - [\![\textbf{laughed}(\textbf{sam})]\!]$

Answers

Yes.

Polar questions

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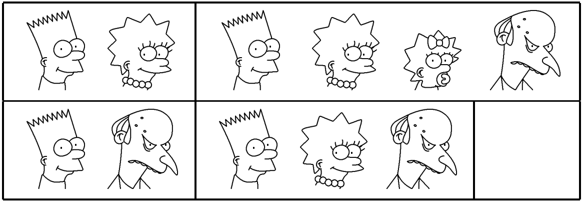
Answers

No.

Constituent questions

$[\![\textit{Who laughed?}]\!] =$

$$\Big\{\{v \in W \mid \forall d.\, [\![\textbf{laugh}]\!](d)(v) \text{ iff } [\![\textbf{laugh}]\!](d)(w)\} \;\Big|\; w \in W\Big\}$$



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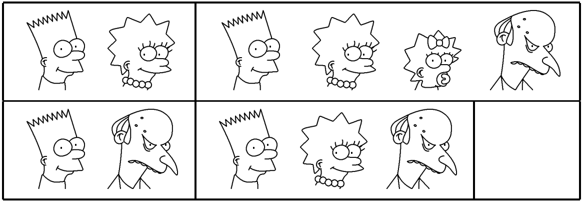

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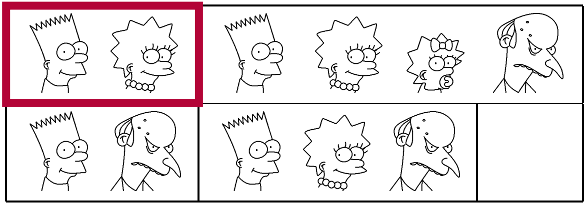

Answers

Bart and Lisa.

Constituent questions

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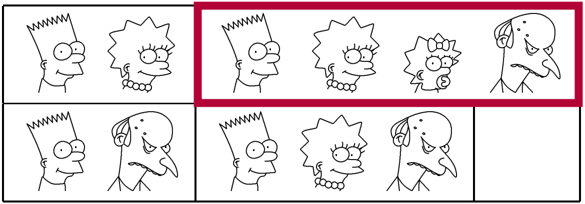

Answers

Bart, Lisa, Maggie, and Burns.

Constituent questions

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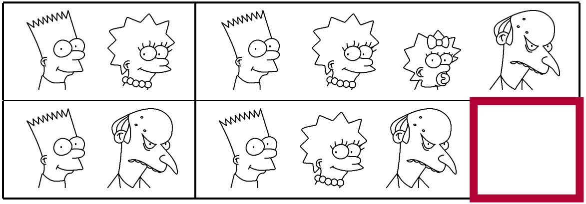

Answers

No one.

Ordering Ans values

We get a rough measure of the extent to which p answers Q by inspecting the cells in Q with which p has a nonempty intersection:

Definition (Answer values)

$$\text{Ans}(p, Q) = \{q \in Q \mid p \cap q \neq \emptyset\}$$

Example

Bart: Did Sam laugh?

Lisa:

$[\![\textbf{laughed(sam)}]\!]$	$W - [\![\textbf{laughed(sam)}]\!]$

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Bart: Did Sam laugh?

Lisa: Yes. $|\mathrm{Ans}| = 1$

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Example

Bart: Did Sam laugh?

Lisa: No. $|\text{Ans}| = 1$

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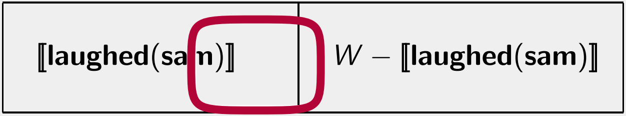
Example

Bart: Did Sam laugh?

Lisa: I heard some giggling. $\qquad |\text{Ans}| = 2$



Overly informative answers

Ans values are a bit too blunt:

$$\text{if } |\,\text{Ans}(p, Q)| = 1, \text{ then } |\,\text{Ans}(p', Q)| = 1 \text{ whenever } p' \subseteq p.$$

Example

Bart: Is Sam happy at his new job?

Lisa:

$[\![\textbf{happy}(\textbf{sam})]\!]$	$W - [\![\textbf{happy}(\textbf{sam})]\!]$

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Example

Bart: Is Sam happy at his new job?

Lisa: Yes, and he hasn't been to jail yet. $|\,\text{Ans}\,| = 1$

$[\![\textbf{happy}(\textbf{sam})]\!]$	$W - [\![\textbf{happy}(\textbf{sam})]\!]$

A preference ordering

Definition (Relevance; G&S, van Rooij)

$$p \succ_Q q \quad \text{iff} \quad \begin{array}{l} \text{Ans}(p, Q) \subset \text{Ans}(q, Q) \text{ or} \\ \text{Ans}(p, Q) = \text{Ans}(q, Q) \text{ and } q \subset p \end{array}$$

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Example

In the previous example,

$$[\![\textbf{happy}(\textbf{sam})]\!] \succ_{[\![?\textbf{happy}(\textbf{sam})]\!]} [\![\textbf{happy}(\textbf{sam}) \wedge \textbf{no-jail}(\textbf{sam})]\!]$$

While their Ans values are the same, the first is a superset of the second.

Ordering questions

We can order questions as well, via the granularity of the cells.

Example

$$\textbf{Where are you from?} \begin{cases} \approx \textbf{Which planet are you from?} \\ \approx \textbf{Which country are you from?} \\ \approx \textbf{Which city are you from?} \\ \ldots \end{cases}$$

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Definition (Fine-grainedness; G&S)

$$Q \sqsubseteq Q' \text{ iff } \forall q \in Q\ \exists q' \in Q'\ q \subseteq q'$$

If Q is more fine-grained than Q', then an exhaustive answer to Q is more informative than an exhaustive answer to Q'.

Conversational implicatures

$\mathcal{A}$	`"Q"`
$\mathcal{B}$	`"p"`

If $[\![p]\!]$ is not maximal with regard to the ordering $\succ_{[\![Q]\!]}$, then `"p"` will be laden with conversational implicatures.

The goal To get a grip on the nature and source of these incongruence implicatures.

Congruence out of incongruence

Zeevat (1994)

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(Surely someone has said the comparable thing for overly informative answers! I haven't found a source yet, though.)

Partial answers

$\mathcal{A}$

What city does Barbara live in?

Moscow	Petersburg	New York	Boston
Kazan	Volgograd	Chicago	Austin

Partial answers

$\mathcal{A}$ — *What city does Barbara live in?* → $\mathcal{B}$ — *Well, she lives in RUSSIA.*

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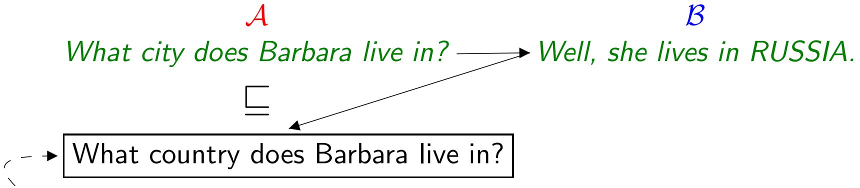
Partial answers



in this case, recoverable from the intonation (Büring, 1999)

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$\mathcal{A}$ — *What city does Barbara live in?* → $\mathcal{B}$ — *Well, she lives in RUSSIA.*

$\sqsubseteq$

What country does Barbara live in?

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$$\left.\begin{array}{r} [\![\textit{Moscow}]\!] \\ [\![\textit{Petersburg}]\!] \\ [\![\textit{Boston}]\!] \\ \vdots \end{array}\right\} \succ_{[\![\textit{What city does Barbara live in?}]\!]} [\![\textit{Russia}]\!]$$

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(The speaker's *motivations* for this partial answer are variable. Some contexts might even enrich it to a complete answer. The pragmatic theory just accounts for the disparity between question and reply.)

Over-answering: A Gricean classic

Is C happy at his new job?

$\mathcal{A}$

Over-answering: A Gricean classic

Is C happy at his new job? ⟶ *Yes, and he hasn't been to prison.*

$\mathcal{A}$ $\mathcal{B}$

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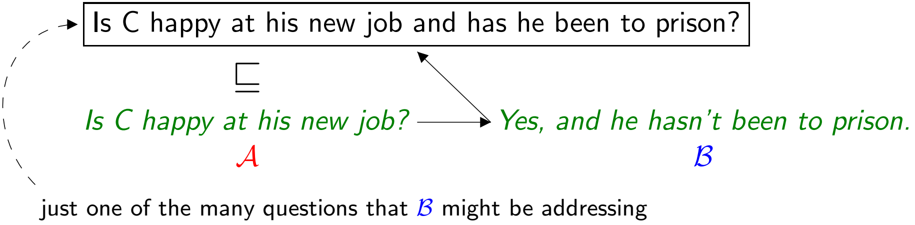

Over-answering: A Gricean classic

Is C happy at his new job and has he been to prison?

$\sqsubseteq$

Is C happy at his new job? → *Yes, and he hasn't been to prison.*

$\mathcal{A}$ $\mathcal{B}$

just one of the many questions that $\mathcal{B}$ might be addressing

Grice (1975)

At this point $\mathcal{A}$ might well inquire what $\mathcal{B}$ was implying, what he was suggesting, or even what he meant by saying that C had not been to prison. The answer might be any one of such things as that C is the sort of person likely to yield to the temptation provided by his occupation, that . . .

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Is C happy at his new job? → *Yes, and he hasn't been to prison.*

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$[\![$*C is happy*$]\!]$	$[\![$*C is not happy*$]\!]$

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$$\left.\begin{matrix}[\![\textit{Yes}]\!] \\ [\![\textit{No}]\!]\end{matrix}\right\} \succ_{[\![\textit{Is C happy at his new job?}]\!]} [\![\textit{Yes, and he hasn't been to jail.}]\!]$$

Over-answering: Pragbot data

Did you find anything?

$\mathcal{A}$

Over-answering: Pragbot data

Did you find anything? → *yep, h at the top exit*

$\mathcal{A}$ $\mathcal{B}$

Over-answering: Pragbot data

Did you find anything and, if so, where is it?

$\sqsubseteq$

Did you find anything? → *yep, h at the top exit*

$\mathcal{A}$ $\mathcal{B}$

(the extra information is a product of the task: they need to retrieve specific cards)

Over-answering: Required for felicity

Is Ali in room 443?

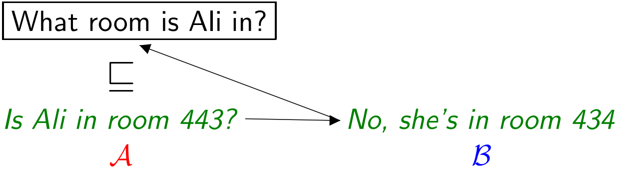
$\mathcal{A}$

Over-answering: Required for felicity

Is Ali in room 443? → *No, she's in room 434*

$\mathcal{A}$ $\mathcal{B}$

Over-answering: Required for felicity



(a nearly conventionalized case of over-answering, though contextual factors can bring out the polar-question understanding)

Over-answering via enrichment

Okay, do we have fire coming up through the roof yet?

$\mathcal{A}$

Over-answering via enrichment

Okay, do we have fire coming up through the roof yet? → *We have a lot of hot embers blowing through.*

$\mathcal{A}$ $\mathcal{B}$

(Strictly speaking, we enrich this to *"No, but..."*, based on our assumptions about the speaker's cooperativity and epistemic state. A robotic "No" would be terrible in this context!)

Over-answering via enrichment

What is the state of the roof?

$\sqsubseteq$

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Incomparables (perhaps)

The relation $\sqsubseteq$ is a partial one, and hence not all questions are comparable along this dimension. Speakers exploit this fact:

Do we have a quiz today?
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The relation $\sqsubseteq$ is a partial one, and hence not all questions are comparable along this dimension. Speakers exploit this fact:

Do we have a quiz today? $\longrightarrow$ *It's rainy outside.*

$\mathcal{A}$ $\mathcal{B}$

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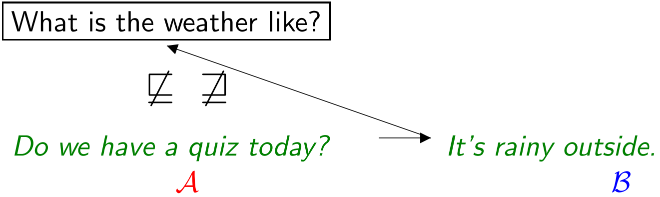

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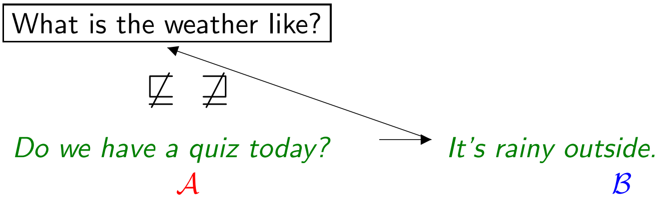

(Topic changing via an answer whose question is incomparable to the original one. However, if it is known that there is always a quiz when the weather is bad, then the two questions might be contextually comparable.)

Uncertainty

Example (After Solan and Tiersma 2005:220)

(**Context**: $\mathcal{B}$ has pocketed $\mathcal{A}$'s wallet.)

$\mathcal{A}$ `I lost my wallet. Do you know where it is?`
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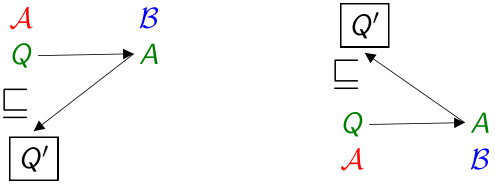
General pragmatic principles and their limits

- Our general pragmatic inferences tell us only that $\mathcal{B}$'s answer is non-maximal, and thus that some other question is in play.
- Our assumptions about the context take us to more specific enrichments.

Desiderata

Earlier, I suggested that we keep two questions in mind:

- What counts as a felicitous answer?
- What shapes the questions themselves?



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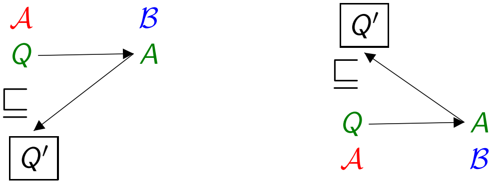

What shapes Q, and what determines Q'?

The final section of this talk introduces some concepts from decision theory, with the goal of answering all these questions.

Decision theory

The study of how (rational) agents make decisions (often under uncertainty (Luce and Raiffa, 1957; Lewis, 1986; Hansson, 2005).

For the purposes of this talk, we require only the basic structure of decision problems. We'll see that, with a decision problem fixed, we gain an understanding of

- where question meanings come from; and
- how two discourse participants might disagree on what the question(s) should be.

Decision problems

Definition (Decision problems)

A decision problem is a structure $DP = (W, S, P_S, A, U_S)$:

- W is a space of possible states of affairs;
- S is an agent;
- P_S is a (subjective) probability distribution for agent S;
- A is a set of actions that S can take; and
- U_S is a utility function for S, mapping action–world pairs to real numbers.

Example: Schlepp the umbrella?

Example (Should agent S bring his umbrella with him?)

The chance of rain is 60%. S is no fan of rain and hates to get wet. It's not good, but not terrible, to carry the umbrella on a dry day. Best of all is sunshine with no umbrella to schlepp.

	rain			no rain	
U_S	w_1	w_2	w_3	w_4	w_5
umbrella	2	2	2	−2	−2
no umbrella	−8	−8	−8	8	8

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Solution concept

S is deciding under uncertainty. If he is rational, he will choose the action with the highest *expected utility* — a calculation that balances his utility values with probabilities.

Expected utilities

Expected utilities take risk into account when measuring the usefulness of performing an action.

Definition

For decision problem $DP = (W, S, P_S, A, U_S)$ the *expected utility* of an action $a \in A$

$$\mathrm{EU}_{DP}(a) = \sum_{w \in W} P(\{w\}) \cdot U(a, w)$$

Solving decision problems

Definition (Utility value of a decision problem)

Let $DP = (W, S, P_S, A, U_S)$ be a decision problem.

$$\mathrm{UV}(DP) = \max_{a \in A} \mathrm{EU}_{DP}(a)$$

Definition (Solving a decision problem)

Let $DP = (W, S, P_S, A, U_S)$ be a decision problem. The solution to DP is

$$\text{choose } a \text{ such that } \mathrm{EU}_{DP}(a) = \mathrm{UV}(DP)$$

Solving the umbrella problem

	rain (.6)	no rain (.4)	EU
umbrella	2	-2	0.4
no-umbrella	-8	4	-1.6

- $\text{UV(Schlepp)} = \max_{a \in \{\textbf{umbrella},\textbf{no-umbrella}\}} \text{EU}(a)$
  $= 0.4$
- The optimal action is **umbrella**.

Utility value of new information

Incoming information might change the decision problem by changing the expected utilities.

Definition (Conditional expected utility)

Let $DP = (W, S, P_S, A, U_S)$ be a decision problem.

$$\mathrm{EU}_{DP}(a|p) = \sum_{w \in W} P(\{w\}|p) \cdot U(a, w)$$

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$$\mathrm{EU}_{DP}(a|p) = \sum_{w \in W} P(\{w\}|p) \cdot U(a, w)$$

Example

- $\mathrm{EU}(\textbf{no-umbrella}) = -1.6$
- $\mathrm{EU}(\textbf{no-umbrella}|\{w_4, w_5\}) = 8.0$ (given no rain)
- $\mathrm{EU}(\textbf{umbrella}) = .4$
- $\mathrm{EU}(\textbf{umbrella}|\{w_1, w_2, w_3\}) = 2.0$ (given no rain)

Changes to the utility value

The utility value of new information is a measure of the extent to which it changes the utility value of the decision problem.

Definition

$$\mathrm{UV}_{DP}(p) = \max_{a \in A} \mathrm{UV}_{DP}(a|p) - \mathrm{UV}(DP)$$

Example

For the umbrella example, the utility value jumps from .4 to 8.0 when we learn that it will be sunny. Thus:

$$\mathrm{UV}_{\mathrm{Schlepp}}(\{w_4, w_5\}) = 8.0$$

Action propositions

Definition (van Rooij)

$DP = (W, S, P_S, A, U_S)$ is a decision problem and $a \in A$.

$$a^* = \{w \in W \mid U_S(a, w) \geqslant U_S(a', w) \text{ for } a' \in A\}$$

Example (Action propositions for schlepping the umbrella)

	rain			no rain	
U_S	w_1	w_2	w_3	w_4	w_5
umbrella	2	2	2	−2	−2
no umbrella	−8	−8	−8	8	8

umbrella$^* = \{w_1, w_2, w_3\}$ **no umbrella**$^* = \{w_4, w_5\}$

Action propositions

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Example (Action propositions for schlepping the umbrella)

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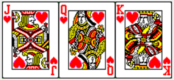
umbrella$^* = \{w_1, w_2, w_3\}$ **no umbrella**$^* = \{w_4, w_5\}$

We've induced a question meaning from the utility function.

Optimal understandings

Example (Pragbot data)

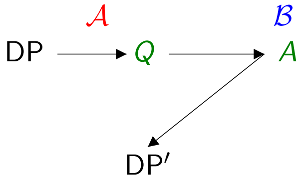
Context: Player 2 is looking for 

```
Player 2:  Did you find anything?
           [...]
Player 1:  yep, h at the top exit
```

	P1 found cards		
	P1 found {J,Q,K}H	P1 found {J,Q,K}S	P1 found no cards
$U_{\mathbf{P2}}$	$w_1 \ldots w_k$	$w_{k+1} \ldots w_m$	$w_{m+1} \ldots w_n$
meet P1	10	0	0
keep searching	0	10	0

A decision-theoretic view of (in)congruence

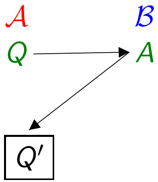
Incongruous answers don't signal an alternative question, but rather an alternative decision problem, one that the answerer would like to address/solve.



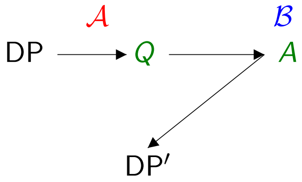
Summing up and looking ahead

A unified pragmatics

Basic relations between questions and between questions and their answers provides a unified perspective on partial answering, over-answering, and the gray area between them.



Summing up and looking ahead



Greater generality via decision theory

The decision-theoretic approach frees us from having to define everything in terms of questions. Decision problems are more general, and thus they can be used to understand other discourse moves.

Info

This material is based upon work supported by Army Research Office contract number W911NF-07-1-0216. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the Army Research Office.

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