Integrated pragmatic values

Christopher Potts

UMass Amherst

Brown University, March 6, 2006

Abstract

I model speakers' perspectives with probability distributions over the set of possible worlds. The *quality-rating* of an utterance is the speaker's probability value for its propositional content. An utterance's *quantity-rating* is the informativity of its content relative to the addressee's probabilities. Quality-ratings act as a check on quantity-ratings. I employ the notion of *relevance to a question* to further articulate these pragmatic values and arrive at a notion of *maximally-felicitous utterance* (in context).

The guiding ideas of this work are due to work by Reinhard Blutner, Gerhard Jäger, Manfred Krifka, Arthur Merin, Craige Roberts, and Robert van Rooij.

Progress in pragmatics

Pragmaticalists[1] have been hard at work on two central issues in the theory of linguistic pragmatics:

1. Increased understanding of the pragmatically useful relations on meanings.

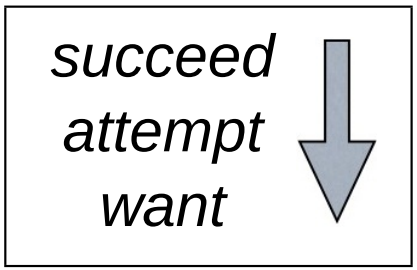
2. Increased understanding of the maxims.

[1] We've yet to settle on a name for ourselves. *Pragmaticist* enjoys some popularity. *Pragmatician* has a perhaps welcome clinical ring. *Pragmateur* is classy. But I favor *pragmaticalist*, with its air of *radical*.

Pragmatically accessible meanings

The range of pragmatically accessible meanings seems to be partly conventionalized (Fauconnier 1975; Horn 1989; Chierchia 2004; Sauerland 2004).

For instance, pragmatic scales seem to be scales of lexical items, rather than meanings themselves.



This suggests that the tools of semantics will prove useful.

The probability of formalizing the maxims

Some are skeptical that we can have a rigorous theory of the maxims.

- Beaver (2001:29) calls formalization in this area "notoriously problematic".
- Bach (1999) is more decisive, offering various reasons why "it seems futile for linguists to seek a formal pragmatics".
- Devitt and Sterelny (1987:§7.4) strike a similar chord.

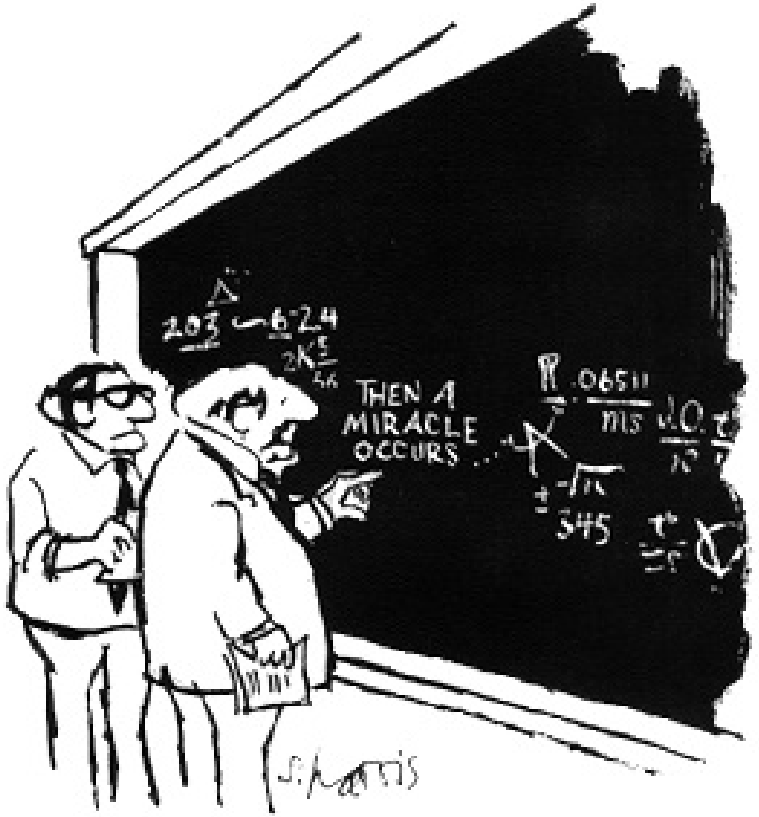
It's a harsh verdict. Maxims (at least one) are the main engine behind all pragmatic theories.

“Then a miracle occurs”

The maxims do not yield easily to a treatment in the usual terms of semantic theory. One can usually be precise up to a point, but then . . .

“Then a miracle occurs”

The maxims do not yield easily to a treatment in the usual terms of semantic theory. One can usually be precise up to a point, but then . . .



"I think you should be more explicit here in step two."

A probable breakthrough

Things are looking up.

Reinhard Blutner, Gerhard Jäger, Arthur Merin, Craige Roberts, Robert van Rooij, and others have shed new light on the situation.

The chief innovation

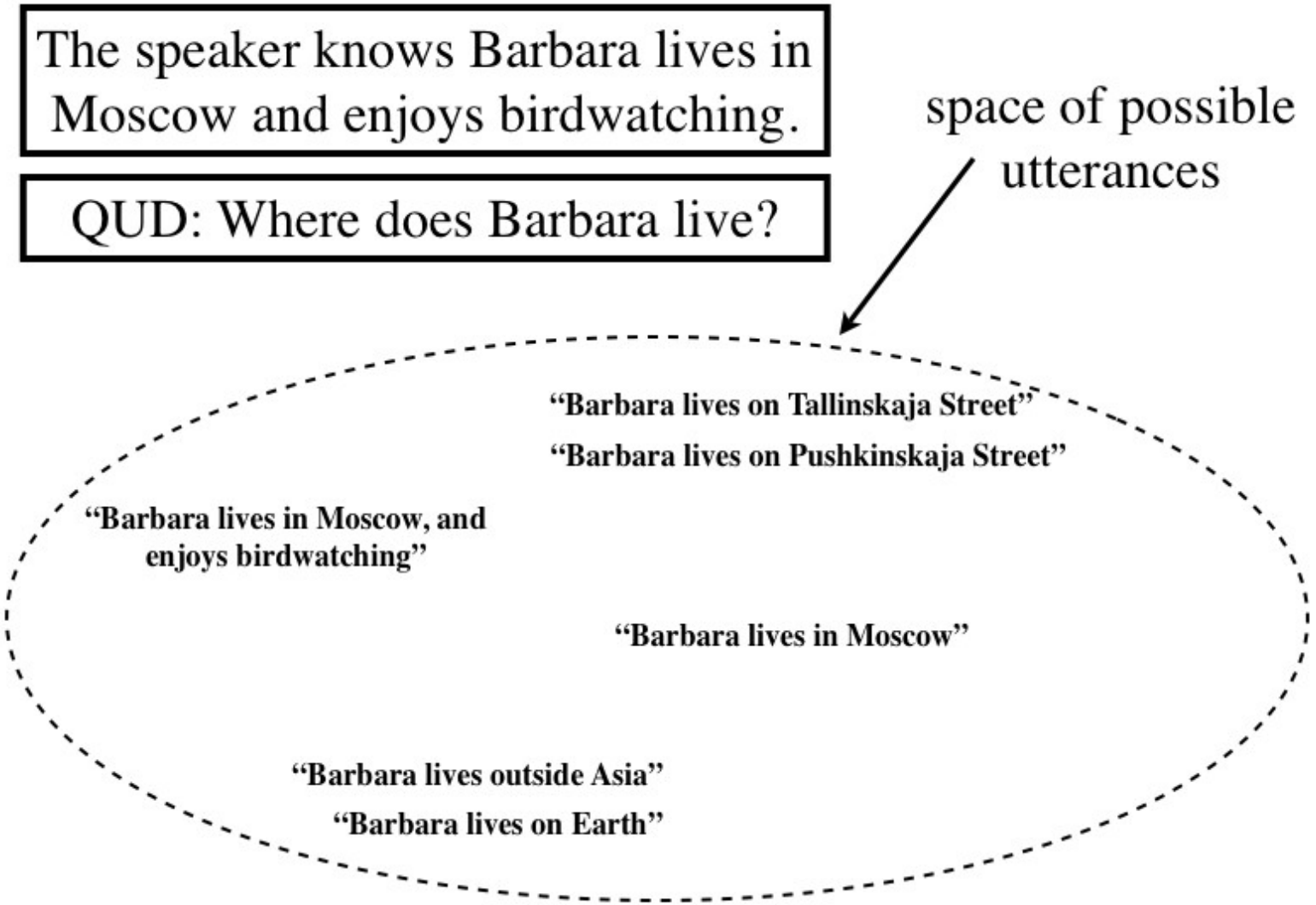
A shift in emphasis from truth-conditions to probabilities.

This talk in words

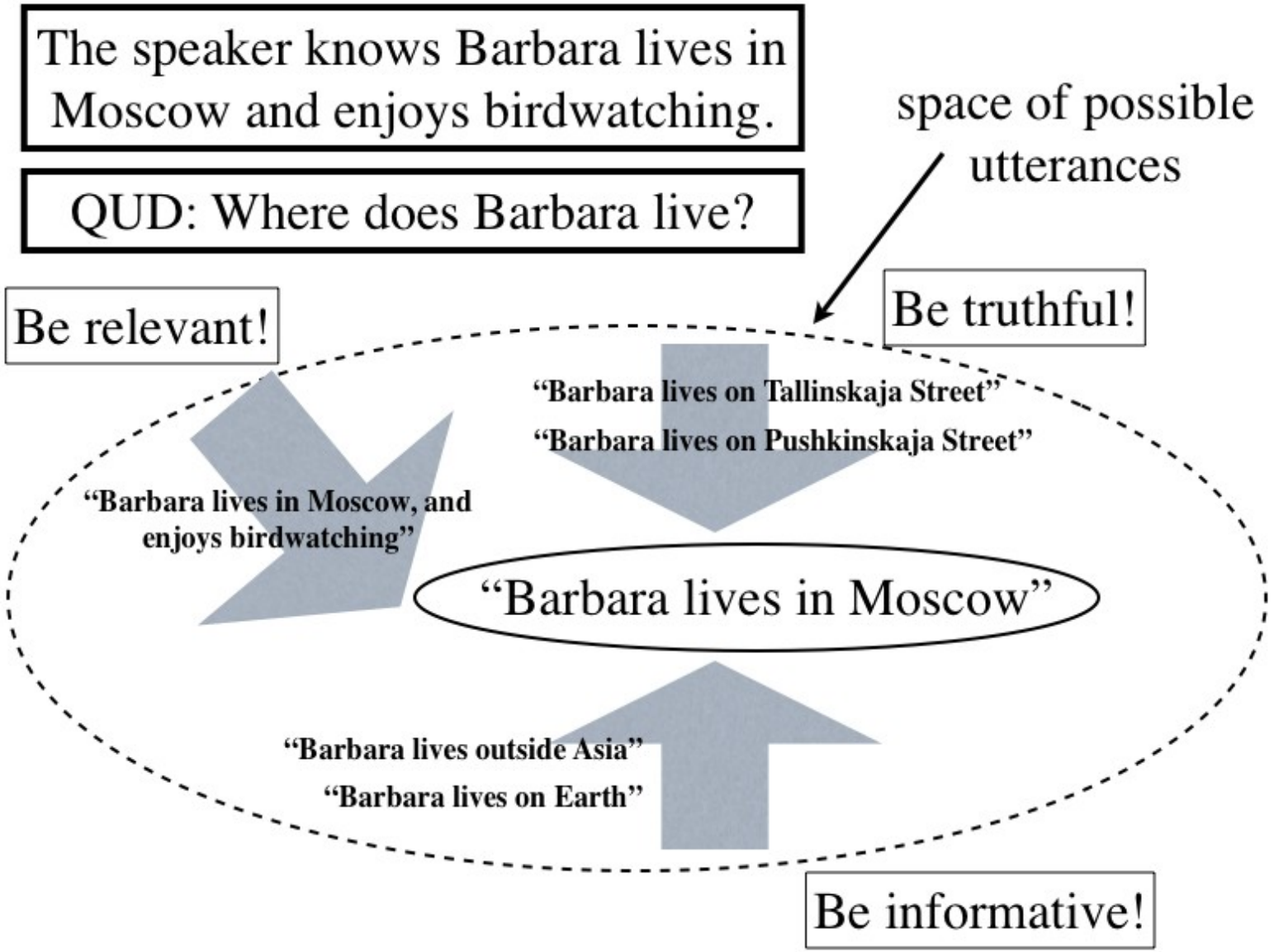
I attempt to formalize Grice's maxims of quality, quantity, and relevance. (For manner, see Blutner 1998; van Rooy 2003c.)

- The theory delivers quality-ratings and quantity-ratings for utterances.
- Particular contexts set particular quality thresholds.
- Propositions are also ranked according to their relevance to the context's question-under-discussion. The rankings are an additional check on the flow of information.
- These ratings combine to yield a notion of *maximally-felicitous utterance* (relative to some context).

This talk in a picture



This talk in a picture



This talk as an interactive script

OVERALL VALUES

[restricted to relevance-ranked propositions with quality ratings above the context standard]

Utterance	Quality	Quantity	Relevance
{1 2}	1	2.000	1
{1 2 7 8}	1	1.000	2
{1 2 5 6}	1	1.000	2
{1 2 3 4}	1	1.000	2
{1 2 5 6 7 8}	1	0.415	3
{1 2 3 4 5 6}	1	0.415	3
{1 2 3 4 7 8}	1	0.415	3
{1 2 3 4 5 6 7 8}	1	-0.000	4

PROPOSITIONS

POWER-SET({ w1 ... w8 })

THE CONTEXT STANDARD

.9 [lenient]

QUD

{ {1 2} {3 4} {5 6} {7 8} }

SPEAKER'S BELIEFS

w1 ⟹ 1.000
w2 ⟹ 0.000
w3 ⟹ 0.000
w4 ⟹ 0.000
w5 ⟹ 0.000
w6 ⟹ 0.000
w7 ⟹ 0.000
w8 ⟹ 0.000

HEARER'S BELIEFS

w1 ⟹ 0.125
w2 ⟹ 0.125

My primary sources

- Informativity measures relevant for quantity: Blutner 1998, 2000; van Rooy 2003c,a; Krifka 2003
- Probability distributions in linguistics: Merin 1997, 2005
- Relevance in general: van Rooy 2004a
- Relevance in interrogative contexts: van Rooy 2003b
- Overview on probabilistic and game-theoretic methods: Benz et al. 2005
- The related conceptual link with Bidirectional OT: Jäger 2002; van Rooy 2004b

The players (discourse participants)

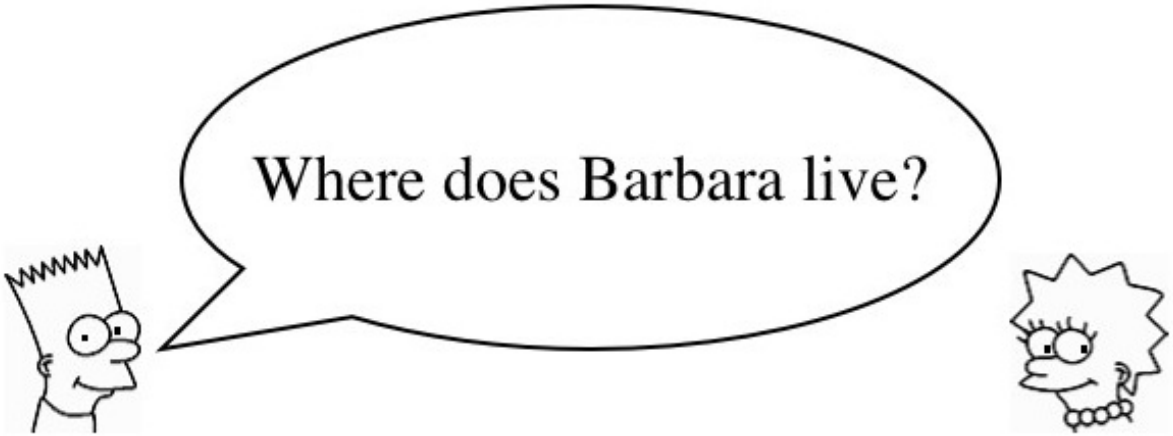
- [Bart]
- [Lisa]

The players' goal (fixed for all scenarios)

Bart and Lisa need to know which city Barbara lives in, so that they can buy plane tickets for themselves.

The question under discussion (QUD)

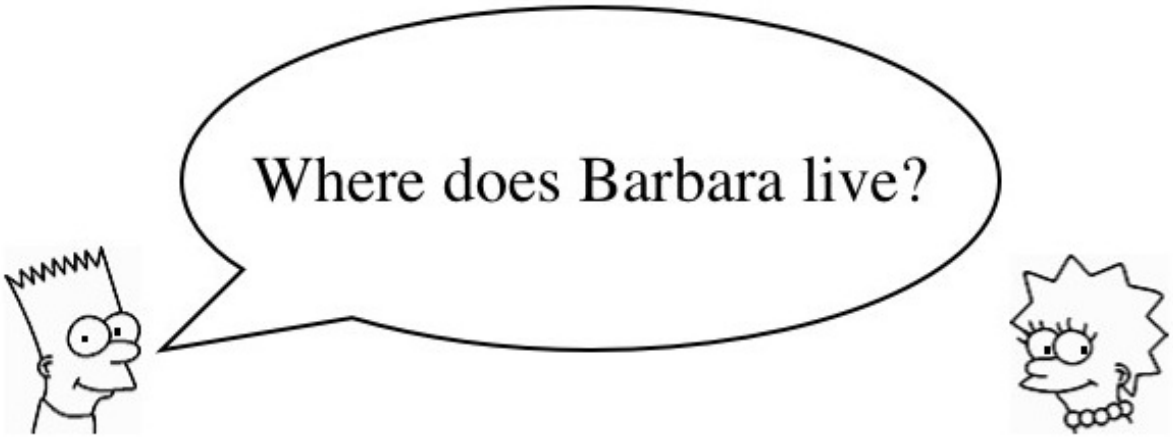
The utterance



[Bart has no knowledge of where Barbara lives.]

The question under discussion (QUD)

The utterance



[Bart has no knowledge of where Barbara lives.]

The utterance's interpretation

- The players need to know which city Barbara lives in.
- They needn't find out anything more specific than that.
- So the QUD is interpreted as equivalent to *Which city does Barbara live in?*

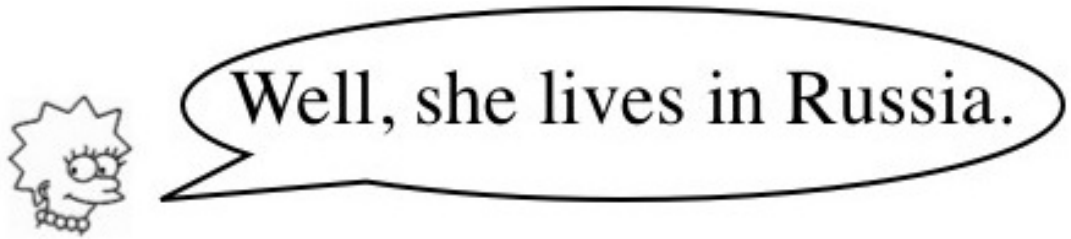
Scenario 1

Goal (fixed): find out Barbara's home city

Lisa's knowledge

Lisa knows which country Barbara lives in: Russia. But she is not sure which city in Russia.

Lisa's reply



Bart's calculation

Bart will conclude that Lisa has limited knowledge, that she was not positioned to name a city.

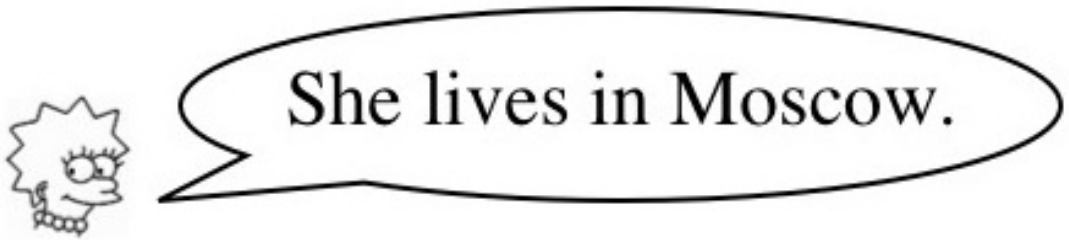
Scenario 2

Goal (fixed): find out Barbara's home city

Lisa's knowledge

Lisa knows Barbara's exact street address: Tallinskaja 2, Moscow.

Lisa's reply



Bart's calculation

Bart will not conclude that Lisa lacks more specific knowledge than this, because she offered the right amount of information given the shared goal of the discourse.

A possible-worlds model for the scenarios

$W = \{w_1 \ldots w_8\}$

$$
\begin{aligned}
[\![\textit{Barbara lives in Moscow}]\!] &= \{w_1, w_2\} \\
[\![\textit{Barbara lives on Tallinskaja St, Moscow}]\!] &= \{w_1\} \\
[\![\textit{Barbara lives on Pushkinskaja St, Moscow}]\!] &= \{w_2\} \\
\\
[\![\textit{Barbara lives in Petersburg}]\!] &= \{w_3, w_4\} \\
[\![\textit{Barbara lives on Kolomenskaja St, Petersburg}]\!] &= \{w_3\} \\
[\![\textit{Barbara lives on Nevsky Prospekt, Petersburg}]\!] &= \{w_4\} \\
\\
[\![\textit{Barbara lives in New York}]\!] &= \{w_5, w_6\} \\
[\![\textit{Barbara lives on 2nd Avenue, NY}]\!] &= \{w_5\} \\
[\![\textit{Barbara lives on Union Square, NY}]\!] &= \{w_6\} \\
\\
[\![\textit{Barbara lives in Northampton}]\!] &= \{w_7, w_8\} \\
[\![\textit{Barbara lives on Main St, Northampton}]\!] &= \{w_7\} \\
[\![\textit{Barbara lives on Pleasant St, Northampton}]\!] &= \{w_8\}
\end{aligned}
$$

Back to the scenarios

Scenario 1

- Bart: state of ignorance ($= W$)
- Lisa: believes Barbara lives in Russia ($= \{w_1 \ldots w_4\}$)

Scenario 2

- Bart: state of ignorance ($= W$)
- Lisa: believes Barbara lives in Moscow, and, moreover, on Tallinskaja ($= \{w_1\}$)

Partitions for the QUD

An ideal answer perfectly matches exactly one cell.

Street-level semantics

$$[\![\textit{Where does Barbara live?}]\!] = \left\{ \begin{array}{cccc} \{w_1\} & \{w_2\} & \{w_3\} & \{w_4\} \\ \{w_5\} & \{w_6\} & \{w_7\} & \{w_8\} \end{array} \right\}$$

City-level semantics

$$[\![\textit{Where does Barbara live?}]\!] = \left\{ \begin{array}{cc} \{w_1, w_2\} & \{w_3, w_4\} \\ \{w_5, w_6\} & \{w_7, w_8\} \end{array} \right\}$$

Country-level semantics

$$[\![\textit{Where does Barbara live?}]\!] = \left\{ \begin{array}{c} \{w_1, w_2, w_3, w_4\} \\ \{w_5, w_6, w_7, w_8\} \end{array} \right\}$$

Probability distributions

An additional perspective on the set of all propositions.

Definition (Probability distributions)

A function $P : \wp(W) \mapsto [0,1]$ is a probability distribution iff

1. $P(W) = 1$
2. $P(\{w\}) \geqslant 0$, for all $w \in W$
3. Probabilities are additive: if p and q are disjoint propositions, then $P(p \cup q) = P(p) + P(q)$

Mimicking propositions (Merin 1997, 2005)

P mimics q

The probability distribution P mimics the proposition q (a subset of W) iff

1. $P(\{w\}) = 0$ iff $w \notin q$
2. $P(\{w\}) = P(\{w'\})$ for all $w, w' \in q$

Mimicking propositions (Merin 1997, 2005)

P mimics q

The probability distribution P mimics the proposition q (a subset of W) iff

1. $P(\{w\}) = 0$ iff $w \notin q$
2. $P(\{w\}) = P(\{w'\})$ for all $w, w' \in q$

Intuitively

- By clause (i), 0 probability mimics non-membership.

Mimicking propositions (Merin 1997, 2005)

P mimics q

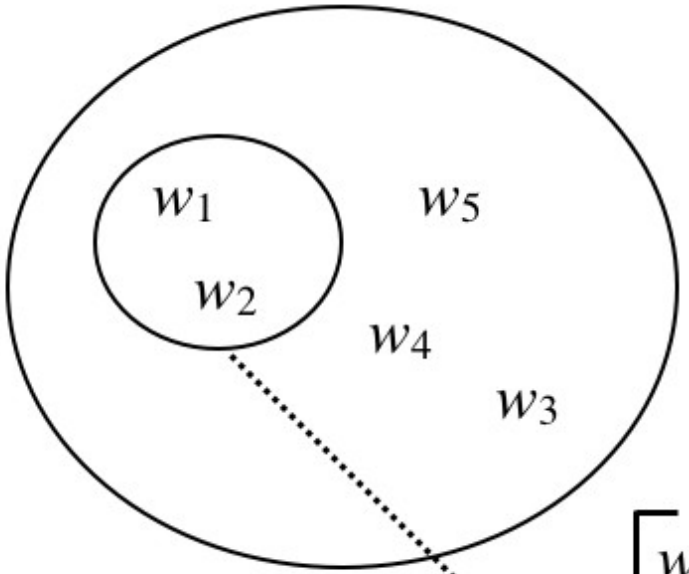
The probability distribution P mimics the proposition q (a subset of W) iff

1. $P(\{w\}) = 0$ iff $w \notin q$
2. $P(\{w\}) = P(\{w'\})$ for all $w, w' \in q$

Intuitively

- By clause (i), 0 probability mimics non-membership.
- By clause (ii), probabilities are evenly distributed across the worlds in the proposition.

Mimicking propositions (Merin 1997, 2005)



$$\begin{bmatrix} w_1 \rightarrow .5 \\ w_2 \rightarrow .5 \\ w_3 \rightarrow 0 \\ w_4 \rightarrow 0 \\ w_5 \rightarrow 0 \end{bmatrix}$$

sum to 1

nonmembers

Conversational-implicature updates [digression]

If we supplement our dynamics with relations on probability distributions, then conversational-implicature updates can function differently than regular updates: implicature *p* might reduce the probabilities of non-*p* worlds, but not all the way to 0 the way that entailments do.

Utterance contexts

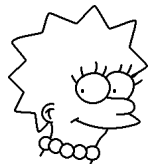
An *utterance context* is a tuple $C = \langle S, P, Q, U^{a_i \mapsto a_j} \rangle$, where

1. $S = \{a_1, a_2, \ldots\}$ is the set of players.
2. $P = \{P_1, P_2, \ldots\}$ is the set of probability distributions, where P_i represents the beliefs of player a_i.
3. $Q \subseteq \wp(W)$ is the question-under-discussion.
4. $U^{a_i \mapsto a_j}$ is an utterance by player $a_i \in S$ to addressee $a_j \in S$.

I often use s to pick out the speaker and a to pick out the addressee. In such cases, I am assuming that $S = \{s, a\}$.

Scenario 1 as an utterance context

$$S = \{ \quad , \quad \}$$

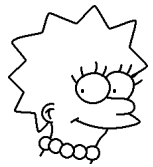


$$P_{[\![\textbf{bart}]\!]} = \begin{bmatrix} P(\{w_1\}) \mapsto .125 \\ P(\{w_2\}) \mapsto .125 \\ P(\{w_3\}) \mapsto .125 \\ P(\{w_4\}) \mapsto .125 \\ P(\{w_5\}) \mapsto .125 \\ P(\{w_6\}) \mapsto .125 \\ P(\{w_7\}) \mapsto .125 \\ P(\{w_8\}) \mapsto .125 \end{bmatrix} \quad P_{[\![\textbf{lisa}]\!]} = \begin{bmatrix} P(\{w_1\}) \mapsto .25 \\ P(\{w_2\}) \mapsto .25 \\ P(\{w_3\}) \mapsto .25 \\ P(\{w_4\}) \mapsto .25 \\ P(\{w_5\}) \mapsto 0 \\ P(\{w_6\}) \mapsto 0 \\ P(\{w_7\}) \mapsto 0 \\ P(\{w_8\}) \mapsto 0 \end{bmatrix}$$

$$Q = [\![\textit{Where does Barbara live?}]\!] = \left\{ \begin{matrix} \{w_1, w_2\} & \{w_3, w_4\} \\ \{w_5, w_6\} & \{w_7, w_8\} \end{matrix} \right\}$$

$$U^{[\![\textbf{lisa}]\!] \mapsto [\![\textbf{bart}]\!]} = \text{“In Russia”}$$

Scenario 2 as an utterance context

$$S = \{ \text{ }, \text{  } \}$$

$$P_{[\![\textbf{bart}]\!]} = \begin{bmatrix} P(\{w_1\}) \mapsto .125 \\ P(\{w_2\}) \mapsto .125 \\ P(\{w_3\}) \mapsto .125 \\ P(\{w_4\}) \mapsto .125 \\ P(\{w_5\}) \mapsto .125 \\ P(\{w_6\}) \mapsto .125 \\ P(\{w_7\}) \mapsto .125 \\ P(\{w_8\}) \mapsto .125 \end{bmatrix} \quad P_{[\![\textbf{lisa}]\!]} = \begin{bmatrix} P(\{w_1\}) \mapsto 1 \\ P(\{w_2\}) \mapsto 0 \\ P(\{w_3\}) \mapsto 0 \\ P(\{w_4\}) \mapsto 0 \\ P(\{w_5\}) \mapsto 0 \\ P(\{w_6\}) \mapsto 0 \\ P(\{w_7\}) \mapsto 0 \\ P(\{w_8\}) \mapsto 0 \end{bmatrix}$$

$$Q = [\![\textit{Where does Barbara live?}]\!] = \left\{ \begin{matrix} \{w_1, w_2\} & \{w_3, w_4\} \\ \{w_5, w_6\} & \{w_7, w_8\} \end{matrix} \right\}$$

$$U^{[\![\textbf{lisa}]\!] \mapsto [\![\textbf{bart}]\!]} = \text{“In Moscow”}$$

Quality (Grice 1975)

> Contribute only what you know to be true. Do not say false things. Do not say things for which you lack evidence.

Quality (Grice 1975)

> Contribute only what you know to be true. Do not say false things. Do not say things for which you lack evidence.

Approximation

An utterance *U* by speaker *s* (in *w*) respects quality iff the semantic value of *U* is a superset of the set of belief worlds for *s* (in *w*).

Quality-ratings

The above view of probability distributions is all we need for a fresh statement of Grice's quality maxim.

Our aim

A gradient view of quality, one that assigns relative values to utterances.

Quality-ratings as probabilities

In scenario 1, Lisa assigns the proposition that Barbara lives on Tallinskaja Street the probability .25.

- Lisa's quality-rating for this content could be .25.

Bart assigns this same proposition the probability .125.

- Bart's quality-rating for this content could be .125.

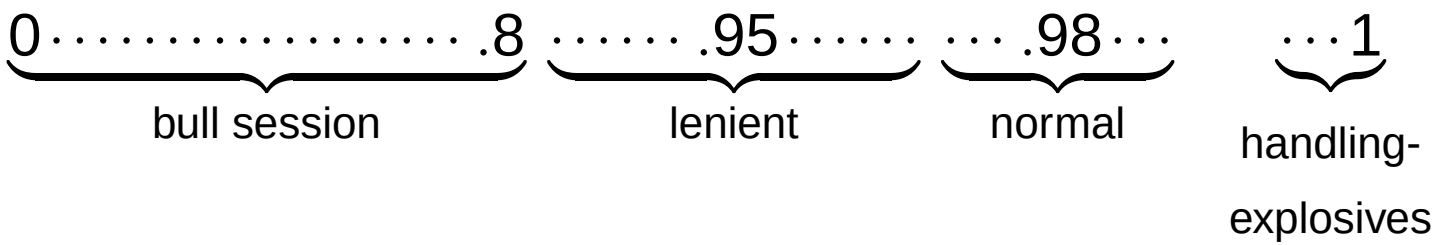
Quality-ratings defined

Basic principle for quality-ratings

An utterance's quality-rating is the probability of its propositional content for the speaker.

Every context imposes a threshold

No utterance with a quality-rating below the threshold can be uttered.



On *bullshit* (Frankfurt 1986)

Frankfurt (1986)

"One of the most salient features of our culture is that there is so much bullshit."

On *bullshit* (Frankfurt 1986)

Bullshitting differs from lying

- The liar cares about the truth. He intends to convey the opposite.
- The bullshitter says things for which he has limited or no evidence, but not with the aim of deceiving. He might hope that what he is saying is true. It's just that he is not justified in his assertions (and doesn't inform you of this fact).

Suggestion

In bull sessions (while bullshitting) quality-ratings hardly matter. The quality-rating threshold is set very low.

Some bullshit

These examples are highly informative but surely not believed by the speaker in any real sense.

- *I could eat a horse!*
- *"I feel like a dog that has been run over."* (Frankfurt 1986)
- *I feel like I'm floating on air.*

The Japanese expressive modal particle *darou*

Hara (2005) shows that Japanese *darou* contributes something like an epistemic modal meaning, but expressively. It is licit only if the sentence it appears in expresses something that the speaker is biased in favor of but crucially lacks hard-and-fast evidence for.

Proposal

S darou is licit only if the semantic value of *S* is something that the speaker has a relatively low quality-rating for — perhaps lawfully below the contextual threshold.

Pragmatic halos

- Lasersohn (1999) observes that almost all of our utterances are, necessarily, approximations of the truth.
- If I claim that Sally arrived at 2:00 when she actually arrived at 1:59, what I say is, in most contexts, close enough to the truth.
- An expression is close enough to the truth (in a context C) iff it is a member of the halo of values that surrounds the truth in C.

Pragmatic halos

- Lasersohn (1999) observes that almost all of our utterances are, necessarily, approximations of the truth.
- If I claim that Sally arrived at 2:00 when she actually arrived at 1:59, what I say is, in most contexts, close enough to the truth.
- An expression is close enough to the truth (in a context C) iff it is a member of the halo of values that surrounds the truth in C.

Proposal

I can claim that Sally arrived at 2:00 even if I assign equal probabilities to the propositions that she arrived at 1:59:00,. . . 2:01:00. All utterances expressing these propositions have degraded quality-ratings — but tolerably so.

If quality reigned supreme

- If quality were the only pressure, speakers would restrict themselves to things with probability of 1.
- But speakers are rarely this confident about informative propositions.
- Speakers take risks with contingent truths. Why?
- They want their utterances to be relevant and contentful.
- The primary function of quality-ratings is to keep the forces of relevance and informativity from growing so powerful that they overwhelm belief.

Quantity

> Make your contribution as informative as is required.
> Do not say more than is required.

Quantity

> Make your contribution as informative as is required.
> Do not say more than is required.

Factoring out "required"

- The "required" portions of this maxim are duplicated by the relevance maxim.
- So quantity is a call for speakers to maximize information content.
- (This injunction is mitigated by quality and relevance.)

Measuring information content

There are many such measures on the market (van Rooy 2004a; Benz et al. 2005). I adopt a version of Blutner's (1998) proposal to derive information content from probabilities using a logarithmic function, in the mode of Carnap (1950).

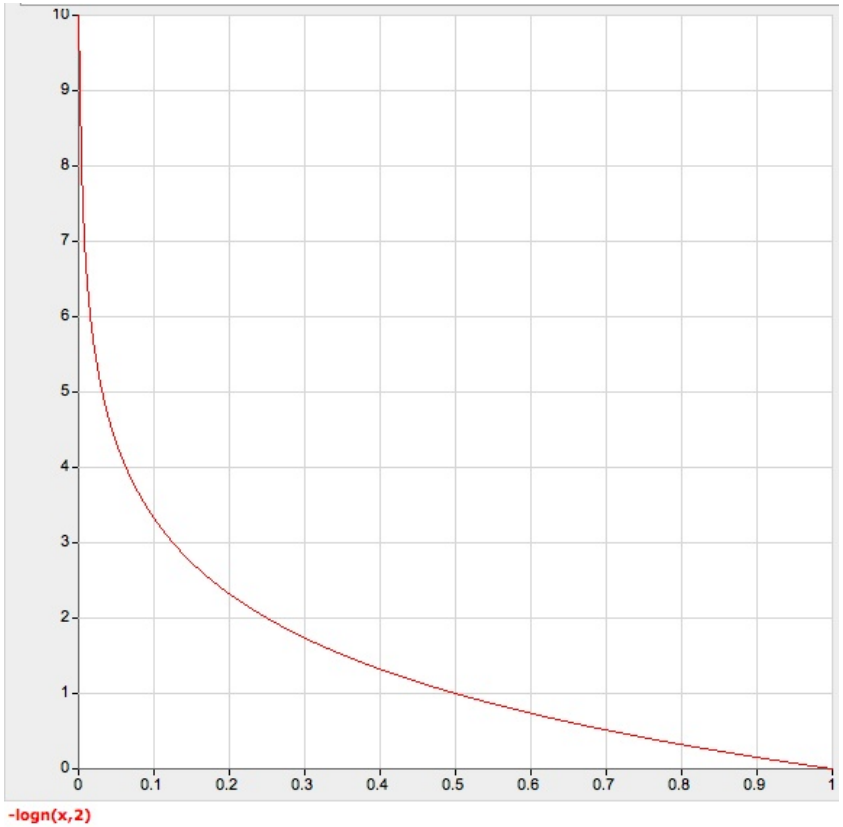
Definition (Information value of p for a)

$$\inf_a(p) = -\log_2 P_a(p)$$

The logarithm/probability inverse relationship

By this measure, informativity values rise as probabilities fall (with the probability of 0 assigned the pathological value ∞):

$-\log_2$



probability

Quantity-ratings

- As with quality, we assign utterances *quantity-ratings*.
- It won't do to identify these with the inf values for propositions relative to the speaker's probability distribution.
- On that approach, the more strongly a speaker believed a proposition *p*, the lower *p*'s information content would be.

The addressee's viewpoint

We should instead use the *addressee's* probability function in calculating the inf values relevant for pragmatics.

The addressee's viewpoint

We should instead use the *addressee's* probability function in calculating the inf values relevant for pragmatics.

To be sure, the speaker can only guess at what this probability distribution is like:

- I might accidentally tell you something you already know, on the mistaken assumption that it is new to you.
- In such cases, the information value of what I said is very low.
- You might also be insulted by my supposition about your belief state.

Quantity-ratings defined

Definition (Quantity-rating)

The *quantity-rating* of the proposition p in context C with addressee a is

$$\text{Quantity}_C(p) = \inf_a(p)$$

A note on quantity-ratings

Gerhard Jäger observes (personal communication) that the present definition of quantity entails that the most desirable thing a speaker can do for his addresseee is surprise him. (My quantity values are called 'surprisal' values by Blutner (1998).)

This is probably unrealistic; we prize confirmation of expectation more than surprise. (Surprises can be jarring and leave us skeptical.)

Jäger suggests that it might be better to measure, not the expressed proposition p, but rather the proposition that the speaker believes p.

Litotes [quantity-ratings and conventionalization]

Majewski (2005) studies expressions like *not exactly happy*, which tend to mean 'miserable'. The pragmatic measures above reveal *not exactly ADJ* to have extremely low quantity-ratings for any choice of *ADJ*. It could be a matter of convention that such uniformative utterances leap to the opposite end of the scale.

Quality–quantity interactions

If quantity were left unchecked, speakers would always choose maximally informative utterances, even if they came at the expense of belief.

Quality acts as a check on quantity. Maximally-informative utterances have low quality-ratings.

Quality as a check on quantity

1. Eliminate from consideration all utterances with quality-ratings below the contextual threshold.
2. From the remaining set, select the utterance with the highest quantity-ratings.
3. (We will still need to add relevance as yet another check on quantity.)

Scenario 1: Had Lisa said “In Moscow”

1. **The scenario 1 quality-rating for “Barbara lives in Moscow”**

$$P_{[\![\textbf{lisa}]\!]}([\![\textit{Barbara lives in Moscow}]\!]) = .5$$

2. **The scenario 1 quantity-rating for “Barbara lives in Moscow”**

$$\inf_{[\![\textbf{bart}]\!]}([\![\textit{Barbara lives in Moscow}]\!]) = -\log_2 .25 = 2$$

Despite its high quantity-rating, this will be highly disfavored in all but the most lenient contexts, due to its low quality-rating.

Scenario 1: Lisa's actual utterance, "In Russia"

1. **The scenario 1 quality-rating for "Barbara lives in Russia"**

$$P_{[\![\textbf{lisa}]\!]}([\![\textit{Barbara lives in Russia}]\!]) = 1$$

2. **The scenario 1 quantity-rating for "Barbara lives in Russia"**

$$\inf_{[\![\textbf{bart}]\!]}([\![\textit{Barbara lives in Russia}]\!]) = -\log_2 .5 = 1$$

"In Russia" vs. "In Moscow"

- The low quality-rating of "In Moscow" puts it out of contention.
- So "In Russia" wins in spite of its lower quantity-rating

A role for relevance

1. **The scenario 2, “Barbara lives on Tallinskaja St”**

$$P_{[\![\textbf{lisa}]\!]}([\![\textit{Barbara lives on Tallinskaja St}]\!]) = 1$$

2. **The scenario 2 quantity-rating for “Barbara lives on Tallinskaja St”**

$$\inf_{[\![\textbf{bart}]\!]}([\![\textit{Barbara lives on Tallinskaja St}]\!]) = -\log_2 .125 = 3$$

“Barbara lives on Tallinskaja St”

- Tied with “In Moscow” (our favored utterance) for quality.
- Higher quantity-rating than “In Moscow”, which gets a 2.

Relevance

Make your contribution relevant.

Relevance

Make your contribution relevant.

Assessment

The concept is left unanalyzed.

Relevance to a question

An ideal answer perfectly matches exactly one cell.

Street-level semantics

$$[\![\textit{Where does Barbara live?}]\!] = \left\{ \begin{array}{cccc} \{w_1\} & \{w_2\} & \{w_3\} & \{w_4\} \\ \{w_5\} & \{w_6\} & \{w_7\} & \{w_8\} \end{array} \right\}$$

City-level semantics

$$[\![\textit{Where does Barbara live?}]\!] = \left\{ \begin{array}{cc} \{w_1, w_2\} & \{w_3, w_4\} \\ \{w_5, w_6\} & \{w_7, w_8\} \end{array} \right\}$$

Country-level semantics

$$[\![\textit{Where does Barbara live?}]\!] = \left\{ \begin{array}{c} \{w_1, w_2, w_3, w_4\} \\ \{w_5, w_6, w_7, w_8\} \end{array} \right\}$$

Answers

Definition (Answers (van Rooy 2003b))

1. $p_Q = \{q \in Q \mid q \cap p \neq \emptyset\}$ (for p an answer to question Q)
2. $\text{Ans}(p, Q) = |p_Q|$

Answers

Definition (Answers (van Rooy 2003b))

1. $p_Q = \{q \in Q \mid q \cap p \neq \emptyset\}$ (for p an answer to question Q)
2. $\text{Ans}(p, Q) = |p_Q|$

Answer to Q

- A complete answer to Q has cardinality 1 by this measure.
- Partial answers have cardinalities greater than 1.
- (Only the empty-set answer has a cardinality of 0.)

A sample calculation

$$\text{QUD} = [\![\textit{Where does Barbara live?}]\!] = \left\{ \begin{array}{ll} \{w_1, w_2\} & \{w_3, w_4\} \\ \{w_5, w_6\} & \{w_7, w_8\} \end{array} \right\}$$

A sample calculation

$$\text{QUD} = [\![\textit{Where does Barbara live?}]\!] = \left\{ \begin{array}{ll} \{w_1, w_2\} & \{w_3, w_4\} \\ \{w_5, w_6\} & \{w_7, w_8\} \end{array} \right\}$$

1. $[\![\textit{Barbara lives on earth}]\!] = \{w_1 \ldots w_8\}$

$$\text{Ans}([\![\textit{Barbara lives on earth}]\!], \text{QUD}) = 4$$

A sample calculation

$$\text{QUD} = [\![\textit{Where does Barbara live?}]\!] = \left\{ \begin{array}{cc} \{w_1, w_2\} & \{w_3, w_4\} \\ \{w_5, w_6\} & \{w_7, w_8\} \end{array} \right\}$$

1. $[\![\textit{Barbara lives on earth}]\!] = \{w_1 \ldots w_8\}$

   $$\text{Ans}([\![\textit{Barbara lives on earth}]\!], \text{QUD}) = 4$$

2. $[\![\textit{Barbara lives in Russia}]\!] = \{w_1 \ldots w_4\}$

   $$\text{Ans}([\![\textit{Barbara lives in Russia}]\!], \text{QUD}) = 2$$

A sample calculation

$$\text{QUD} = [\![\textit{Where does Barbara live?}]\!] = \left\{ \begin{array}{ll} \{w_1, w_2\} & \{w_3, w_4\} \\ \{w_5, w_6\} & \{w_7, w_8\} \end{array} \right\}$$

1. $[\![\textit{Barbara lives on earth}]\!] = \{w_1 \ldots w_8\}$

   $$\text{Ans}([\![\textit{Barbara lives on earth}]\!], \text{QUD}) = 4$$

2. $[\![\textit{Barbara lives in Russia}]\!] = \{w_1 \ldots w_4\}$

   $$\text{Ans}([\![\textit{Barbara lives in Russia}]\!], \text{QUD}) = 2$$

3. $[\![\textit{Barbara lives in Moscow}]\!] = \{w_1, w_2\}$

   $$\text{Ans}([\![\textit{Barbara lives in Moscow}]\!], \text{QUD}) = 1$$

A sample calculation

$$\text{QUD} = [\![\textit{Where does Barbara live?}]\!] = \left\{ \begin{array}{cc} \{w_1, w_2\} & \{w_3, w_4\} \\ \{w_5, w_6\} & \{w_7, w_8\} \end{array} \right\}$$

1. $[\![\textit{Barbara lives on earth}]\!] = \{w_1 \ldots w_8\}$

   $$\text{Ans}([\![\textit{Barbara lives on earth}]\!], \text{QUD}) = 4$$

2. $[\![\textit{Barbara lives in Russia}]\!] = \{w_1 \ldots w_4\}$

   $$\text{Ans}([\![\textit{Barbara lives in Russia}]\!], \text{QUD}) = 2$$

3. $[\![\textit{Barbara lives in Moscow}]\!] = \{w_1, w_2\}$

   $$\text{Ans}([\![\textit{Barbara lives in Moscow}]\!], \text{QUD}) = 1$$

4. $[\![\textit{Barbara lives on Tallinskaja Street}]\!] = \{w_1\}$

   $$\text{Ans}([\![\textit{Barbara lives on Tallinskaja Street}]\!], \text{QUD}) = 1$$

On Ans values

- Ans values are highly dependent upon the question under discussion.
- Ans ranks propositions according to how well they answer a given question.
- But Ans cannot be the only factor in calculating relevance: scenario 2 distinguishes, e.g.,
  - “Barbara lives in Moscow” (Ans of 1 in scenario 2)
  - “Barbara lives on Tallinskaja Street”. (Ans of 1 in scenario 2)

Relevance-ranking

Too much information can decrease relevance (Sperber and Wilson 1995; van Rooy 2003c).

Definition (Relevance-ranking)

The relevance-ranking of propositions with respect to a question Q is the numerical ordering induced by Ans, except that we throw out (do not rank) a proposition p iff there is a proposition q with the same Ans value as p but a lower Quantity value than p.

In words

If two propositions answer the QUD equally well (have identical Ans values), then the more informative one is eliminated.

A look at scenario 2

Lisa is in a position to offer a more informative answer than she did. But her answer is felicitous. Why?

- The players have asked the question “Where does Barbara live?” at the city level.
- Thus, “Barbara lives in Moscow” and “Barbara lives on Tallinskaja Street” share the relevance value of 1.
- But “Barbara lives in Moscow” is less informative than “Barbara lives on Tallinskaja Street”.
- By relevance-ranking, “Barbara lives on Tallinskaja” is eliminated from pragmatic consideration (not even relevance-ranked).

Overall pragmatic values, with a threshold above .5

	Scenario 1 rankings	Quality	Quantity	relevance ranking	Ans
	B. lives on Tallinskaja	.25	3	—	1
	B. lives on Pushkinskaja	.25	3	—	1
	B. lives in Moscow	.5	2	1	1
	B. lives in Petersburg	.5	2	1	1
⋆	B. lives in Russia	1	1	2	2

1. Eliminate utterances with quality-ratings below the threshold.
2. Eliminate utterances without relevance rankings.
3. Select from the remaining set the utterances with the highest quantity values.

Overall pragmatic values, with a threshold above .5

	Scenario 1 rankings	Quality	Quantity	relevance ranking	Ans
	B. lives in Moscow	.5	2	1	1
	B. lives in Petersburg	.5	2	1	1
⋆	B. lives in Russia	1	1	2	2

1. Eliminate utterances with quality-ratings below the threshold.
2. Eliminate utterances without relevance rankings.
3. Select from the remaining set the utterances with the highest quantity values.

Overall pragmatic values, with a threshold above .5

Scenario 1 rankings	Quality	Quantity	relevance ranking	Ans
⋆ B. lives in Russia	1	1	2	2

1. Eliminate utterances with quality-ratings below the threshold.
2. Eliminate utterances without relevance rankings.
3. Select from the remaining set the utterances with the highest quantity values.

Overall pragmatic values, with a threshold above .5

	Scenario 2 rankings	Quality	Quantity	relevance ranking	Ans
	B. lives on Tallinskaja	1	3	—	1
	B. lives on Pushkinskaja	0	3	—	1
⋆	B. lives in Moscow	1	2	1	1
	B. lives in Petersburg	0	2	1	1
	B. lives in Russia	1	1	2	2

1. Eliminate utterances with quality-ratings below the threshold.
2. Eliminate utterances without relevance rankings.
3. Select from the remaining set the utterances with the highest quantity values.

Overall pragmatic values, with a threshold above .5

	Scenario 2 rankings	Quality	Quantity	relevance ranking	Ans
⋆	B. lives in Moscow	1	2	1	1
	B. lives in Petersburg	0	2	1	1
	B. lives in Russia	1	1	2	2

1. Eliminate utterances with quality-ratings below the threshold.
2. Eliminate utterances without relevance rankings.
3. Select from the remaining set the utterances with the highest quantity values.

Overall pragmatic values, with a threshold above .5

Scenario 2 rankings	Quality	Quantity	relevance ranking	Ans
⋆ B. lives in Moscow	1	2	1	1
B. lives in Russia	1	1	2	2

1. Eliminate utterances with quality-ratings below the threshold.
2. Eliminate utterances without relevance rankings.
3. Select from the remaining set the utterances with the highest quantity values.

Maximally-felicitous utterances

Definition (Maximally-felicitous utterances)

Let C be a context with question-under-discussion Q and players s and a. The set of maximally felicitous utterances in C is set of utterances $U^{s \mapsto a}$ whose propositional content have the highest quantity-ratings and lowest relevance rankings of all the relevance-ranked propositions in C that have quality-ratings above the threshold.

Summary

$U^{s \mapsto a}$ has content p. The QUD is Q.

- The quality-rating of $U^{s \mapsto a}$ is the speaker's probability for p.
- Different contexts set different quality thresholds.
- The quantity-rating of $U^{s \mapsto a}$ is the information value of p according to a's probabilities.
- Quality-ratings mitigate quantity-ratings, because the contextual threshold can get rid of informative utterances that the speaker does not completely believe.
- $U^{s \mapsto a}$ is maximally felicitous iff it has the highest quantity-rating of the relevance-ranked propositions that have quality-ratings above the contextual threshold.

Solving for an utterance

In this talk, we explored the following:

Given

- the speaker's belief state,
- the hearer's belief state, and
- the question under discussion,

which are the most felicitous utterances?

Solving for a question under discussion

Suppose we instead asked

Given

- the speaker's belief state,
- the hearer's belief state, and
- the speaker's utterance,

what must the speaker have in mind as the QUD?

Solving for the speaker's belief state

Or we could ask

Given

- the hearer's belief state,
- the question under discussion, and
- the speaker's utterance,

what must the speaker's belief state be like?

Solving for the speaker's belief state

Output from a second interactive Perl script:

1 => 0.500 2 => 0.500 3 => 0 4 => 0	quality-rating: 1.000 relevance-ranking: 1

1 => 0 2 => 1.000 3 => 0 4 => 0	quality-rating: 1.000 relevance-ranking: 1

1 => 1.000 2 => 0 3 => 0 4 => 0	quality-rating: 1.000 relevance-ranking: 1

HEARER ASSUMPTIONS

1. The speaker's utterance has a quality-rating above the context standard
2. The speaker has uttered something with the lowest relevance-ranking possible given his belief state.

HEARER INFERENCE

In light of the above assumptions, the speaker's belief state must be represented by one of the probability distributions at right.

INFORMATION ABOUT THE CURRENT CONTEXT	
Context standard:	.9
Utterance content:	{ 1 2 }
Relevance-ranking of utterance:	1

Question under discussion:	{
	{1 2}
	{3 4}
	}

Acknowledgments

I've benefitted from an amazing amount of useful feedback on this general project. I'm indebted in particular to Jan Anderssen, Ash Asudeh, Rajesh Bhatt, Daniel Büring, Donna Byron, Shai Cohen, Regine Eckhardt, Kathryn Flack, Lyn Frazier, Yurie Hara, Larry Horn, Gerhard Jäger, Ed Keenan, Angelika Kratzer, Manfred Krifka, Barbara Partee, Craige Roberts, Tim Roeper, Tom Roeper, David Schueler, Florian Schwarz, Tim Stowell, Anna Verbuk, Mike White and audiences at the UMass Amherst Semantics Group (Sep 6, 2005), Göttingen University (Sep 21, 2005), ZAS (Sep 23, 2005), UCLA (Dec 1, 2005), Yale (Nov 7, 2005), OSU (Feb 24, 2006), and Brown (Mar 6, 2006).

References I

Bach, Kent. 1999. The semantics–pragmatics distinction: What it is and why it matters. In Ken Turner, ed., *The Semantics–Pragmatics Interface from Different Points of View*, 65–84. Oxford: Elsevier. URL `http://online.sfsu.edu/~kbach/spd.htm`.

Beaver, David Ian. 2001. *Presupposition and Assertion in Dynamic Semantics*. Stanford, MA: CSLI.

Benz, Anton, Gerhard Jäger, and Robert van Rooij. 2005. An introduction to game theory for linguists. In Anton Benz, Gerhard Jäger, and Robert van Rooij, eds., *Game Theory and Pragmatics*. Basingstoke, Hampshire: Palgrave McMillan.

Blutner, Reinhard. 1998. Lexical pragmatics. *Journal of Semantics* 15(2):115–162.

Blutner, Reinhard. 2000. Some aspects of optimality in natural language interpretation. *Journal of Semantics* 17(3):189–216.

Carnap, Rudolph. 1950. *Logical Foundations of Probability*. Chicago: University of Chicago Press.

Chierchia, Gennaro. 2004. Scalar implicatures, polarity phenomena, and the syntax/pragmatics interface. In Adriana Belletti, ed., *Structures and Beyond*. Oxford: Oxford University Press. [The manuscript began circulating in 2001].

Devitt, Michael and Kim Sterelny. 1987. *Language and Reality: An Introduction to the Philosophy of Language*. Cambridge, MA: MIT Press.

Fauconnier, Gilles. 1975. Polarity and the scale principle. In *Papers of the Eleventh Regional Meeting of the Chicago Linguistic Society*, 188–199. Chicago: Chicago Linguistic Society.

References II

Frankfurt, Harry G. 1986. On bullshit. *Raritan* 6(2):81–100. Reprinted in Frankfurt (1988), 117–133.

Frankfurt, Harry G. 1988. *The Importance of What we Care About*. Cambridge University Press.

Grice, H. Paul. 1975. Logic and conversation. In Peter Cole and Jerry Morgan, eds., *Syntax and Semantics*, Volume 3: Speech Acts, 43–58. New York: Academic Press.

Hara, Yurie. 2005. Modal-meaning as expressive, Paper to be presented at Sinn und Bedeutung 10, Berlin.

Horn, Laurence R. 1989. *A Natural History of Negation*. Chicago: University of Chicago Press. Reissued 2001 by CSLI.

Jäger, Gerhard. 2002. Some notes on the formal properties of bidirectional Optimality Theory. *Journal of Logic, Language and Information* 11(4):427–451.

Krifka, Manfred. 2003. Polarity items in questions, Invited talk, Korean Society of Logic and Information, Inha University, Incheon, Korean, June 28.

Lasersohn, Peter. 1999. Pragmatic halos. *Language* 75(3):522–551.

Majewski, Helen. 2005. Polarity-sensitive *exactly*, Ms., University of Massachusetts, Amherst.

Merin, Arthur. 1997. If all our arguments had to be conclusive, there would be few of them. Arbeitspapiere SFB 340 101, University of Stuttgart, Stuttgart. URL `http://semanticsarchive.net/Archive/jVkZDI3M/`.

References III

Merin, Arthur. 2005. Probabalistic and deterministic presuppositions. In Rainer Bäuerle, Uwe Reyle, and Thomas Ede Zimmermann, eds., *Presuppositions and Discourse: Essays Offered to Hans Kamp*. Amsterdam: Elsevier. URL `http://semanticsarchive.net/Archive/GE0MGM5N/`.

van Rooy, Robert. 2003a. Negative polarity items in questions: Strength as relevance. *Journal of Semantics* 20:239–273.

van Rooy, Robert. 2003b. Questioning to resolve decision problems. *Linguistics and Philosophy* 26(6):727–763.

van Rooy, Robert. 2003c. Relevance and bidirectional OT. In Reinhard Blutner and Henk Zeevat, eds., *Pragmatics in Optimality Theory*, 173–210. Oxford: Palgrave Macmillan.

van Rooy, Robert. 2004a. Relevance of complex sentences, Ms., University of Amsterdam.

van Rooy, Robert. 2004b. Signalling games select Horn strategies. *Linguistics and Philosophy* 27(4):493–527.

Sauerland, Uli. 2004. Scalar implicatures in complex sentences. *Linguistics and Philosophy* 27(3):367–391.

Sperber, Dan and Deirdre Wilson. 1995. *Relevance: Communication and Cognition*. Oxford: Blackwell, 2 ed.