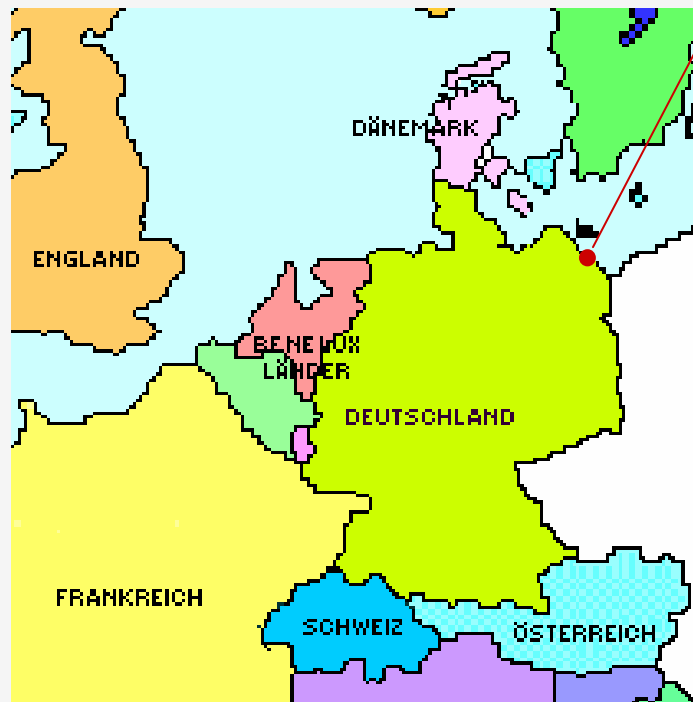# Emotions as metarepresentational states of mind

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Contribution to the Symposium "Agent Construction and Emotions" (ACE2006) at the 18th European Meeting on Cybernetics and Systems Research, Vienna

Where is Greifswald?

...in the Northeast of Germany
...at the shore of the Baltic sea
...220km to Berlin
...pretty much at the center of the European Union

Overview

- The starting point: The cognitive-motivational (belief-desire) theory of emotion
- Naturalizing the belief-desire theory of emotion
- Emotions as nonconceptual metarepresentations
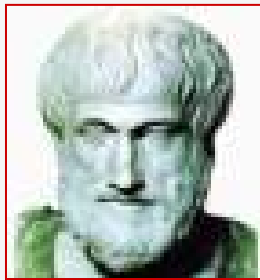- (*Arguments for the Theory*)
- Conclusion

The starting point

Cognitive theories of emotion;

Belief-desire theory

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Emotions as metarepresentations

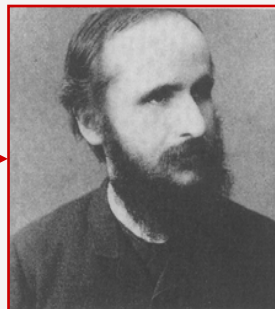# Cognitive theories of emotion in philosophy and psychology

Aristotle

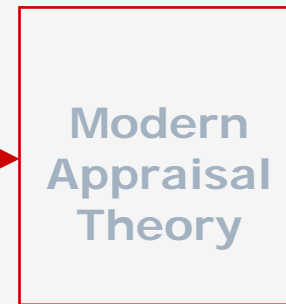■ Originators: Greek philosophers

■ Reeinvented by the Austrians!

Franz Brentano (1883-1917) VIENNA

Alexius Meinong (1853-1920) GRAZ

Magda Arnold (1903-2002) Major work: 1960

Modern Appraisal Theory

Meinong's Belief-Desire theory of emotions:
(1) Beliefs are necessary for emotions

"One cannot feel joy without feeling joy about something." (p. 25)

"Hence one cannot feel joy without **apprehending** this 'something', the object. And it seems evident that this apprehending is essentially a **cognitive** achievement."

"More precisely, the intellectual precondition of the feeling of joy is…**being convinced**, hence a **judgment**…
It is thus essential for joy to have a judgment as a psychological precondition."

For example, if little Albert is to experience joy about his birthday present, he must **believe** that he got the present.

Meinong's Belief-Desire theory of emotions:
(2) Desires are also necssary for emotions
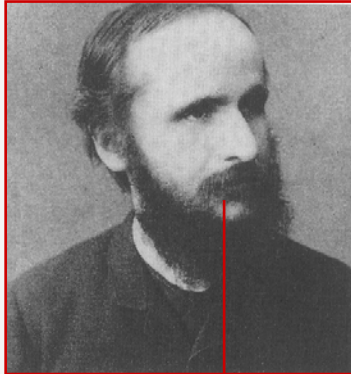
- The belief that a state of affairs p obtains is not sufficient to cause joy about p—an additional factor is needed.

- In many cases at least, the additional factor needed is a motivational state, a desire for or an aversion against p.

For example, if little Albert is to experience joy about his birthday present, he must also have **desired** getting the present.

Des(p)

Bel(p)

Happy(p)

New information
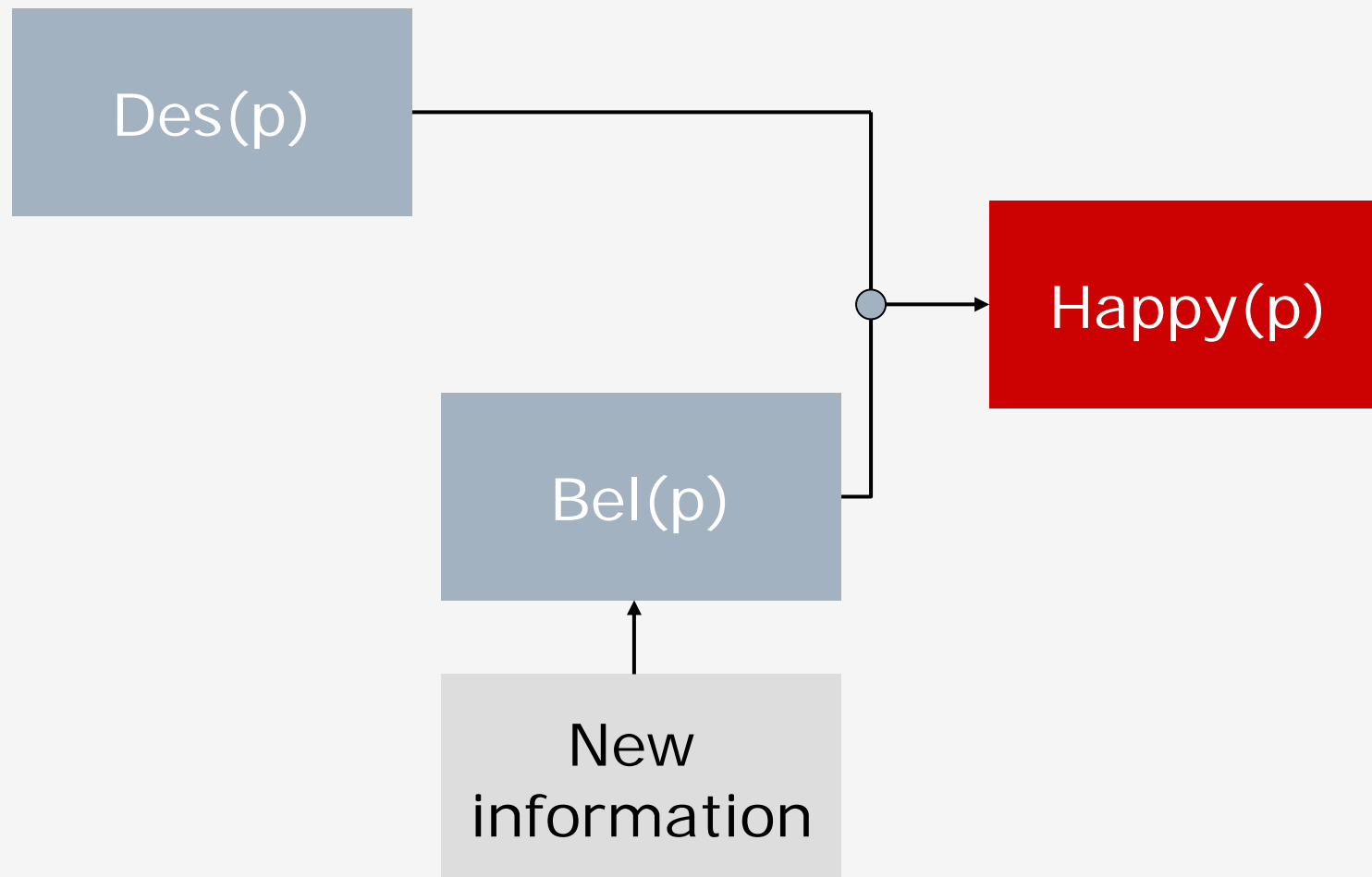
Belief-Desire analysis of some **specific** emotions, Qualitative form

Emotion	IF	Belief at t	Desire at (up to) t	Belief at t-1
happy(p,t)		Certain(p,t)	Des(p,t)	
unhappy(p,t)		Certain(p,t)	Des(¬p,t)	
hopes(p,t)		Uncertain(p,t)	Des(p,t)	
fears(p,t)		Uncertain(p,t)	Des(¬p,t)	
surprised(p,t)		Certain(p,t)	*irrelevant*	Bel(¬p,t-1)
disappointed(¬p,t)		Certain(¬p,t)	Des(p,t)	Bel(p,t-1)
relieved(¬p,t)		Certain(¬p,t)	Des(¬p,t-1)	Bel(p,t-1)

Notation:

Bel(p,t)...believes p at t

Certain(p,t)...firmly believes p at t

Uncertain(p,t) iff Bel(p,t) & ¬Certain(p,t) & ¬Certain (¬p,t)

Des(p,t)...desires p at t

Des(¬p,t)...desires not-p at t (≈ is aversive against p)

Belief-Desire theory, Quantitative form
Examples: Hope and fear

$$p_{a,t} \times d_{a,t}$$

Hope-Fear$_{a,t}$

Event (outcome) a

$d_{a,t}$

$p_{a,t}$

Multiplicative combination
is traditionally assumed in
cognitive models of hope
and fear

Event (outcome) b $d_{b,t}$

$p_{b,t}$

abs(x) needed
only to make
fear function
values positive

Hope-Fear$_{b,t}$

$$p_{b,t} \times d_{b,t}$$
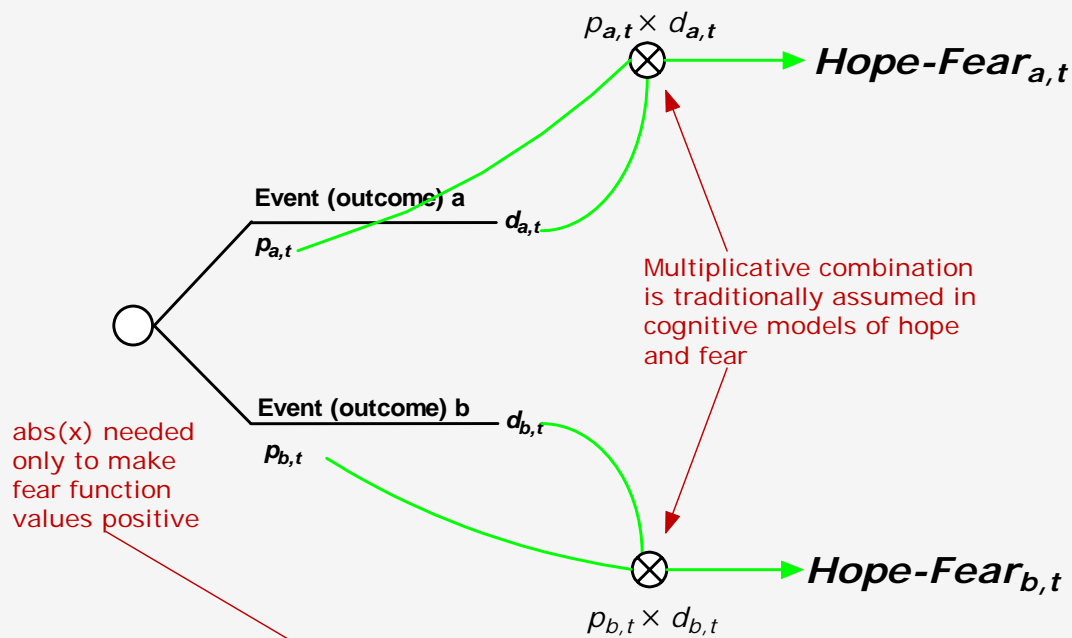
$Hope_{o,t} = \phi_h \, [p_{o,t} \times d_{o,t}]$ if $p_{o,t} < 1$ & $d_{o,t} \geq 0$; else 0

$Fear_{o,t} = \phi_f \, [|p_{o,t} \times d_{o,t}|]$ if $p_{o,t} < 1$ & $d_{o,t} \leq 0$; else 0

ϕ_h, ϕ_f is strictly monotonically increasing

Hope

Fear

Naturalizing the Belief-Desire theory of emotion I

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Emotions as metarepresentations
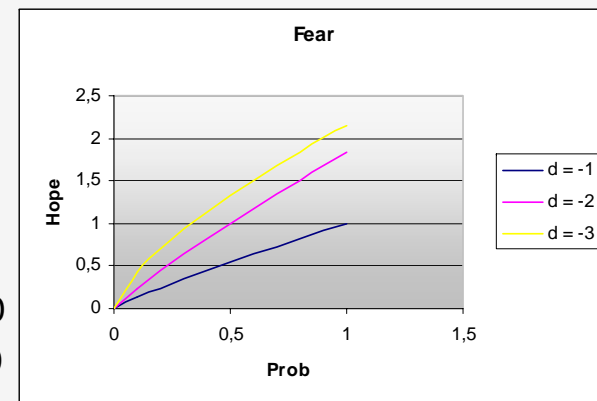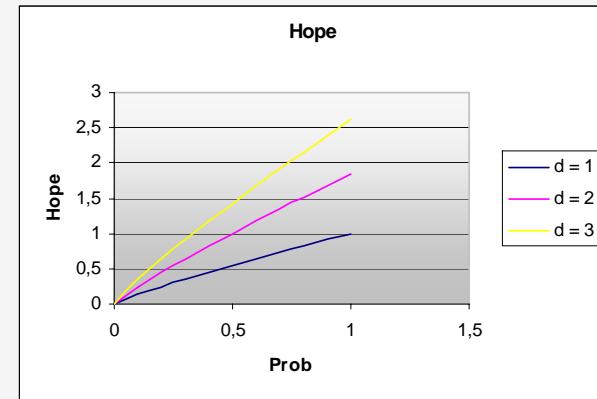
Naturalizing BDTE: Aims

- Sketch of a computational model of BDTE, motivated by the desire to "naturalize" BDTE and to clarify these questions:

- Q1 What is the process that mediates between beliefs/desires and emotions?

- Q2 What is the emotion?

- Q3 What is the function of emotions in a BD-system?

?

?

?

Des(p)

Pleased(p)

Functional effects

Bel(p)

New information

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Emotions as metarepresentations
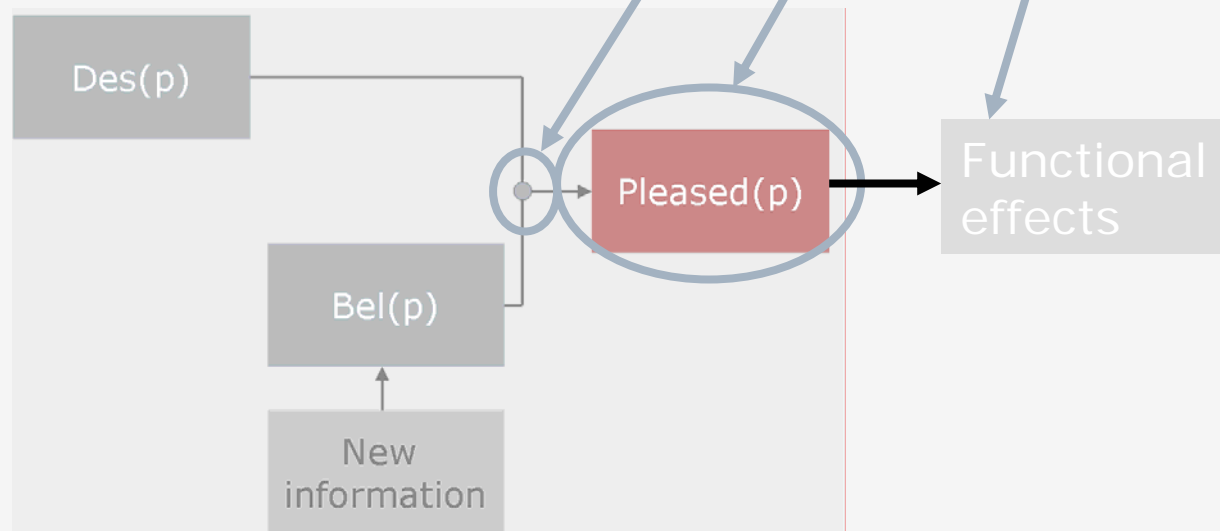
Naturalizing the Belief-Desire-Theory of Emotion: Basic architectural assumptions

- Mental (esp. cognitive) processes are computations in internal representation systems

- The representation systems of humans comprise at their core a system of "propositional" representations (a "language of thought", LOT)

- Believing and desiring are two basic, irreducible modes of processing propositional representations (= sentences in the language of thought; Fodor, 1987)

A moment in Mary's belief-desire system

'Schroiber does not win the election' is in Mary's belief store at t

Belief store (preexisting beliefs)
• I will not be invited to Paul's party. • **Schroiber does not win the election.** • I won't win a million Euros in the lottery. • My daughter is sick. • John does not get what he deserves. • …

Desire store (preexisting desires)
• I will be invited to Paul's party. • **Schroiber wins the election.** • I win a million Euros in the lottery. • My daughter is not sick. • John gets what he deserves. • …

'Schroiber wins the election' is in Mary's desire store at t

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Emotions as metarepresentations

- The BD-system comes equipped with mechanisms that monitor and, if necessary, update the system in response to newly acquired information (beliefs)

- The core of the monitor-and-update mechanisms consists of two comparator mechanisms:

  - Belief-Desire-Comparator (BDC): Compares newly acquired beliefs with existing desires

  - Belief-Belief-Comparator (BBC): Compares newly acquired beliefs with existing beliefs

System designer
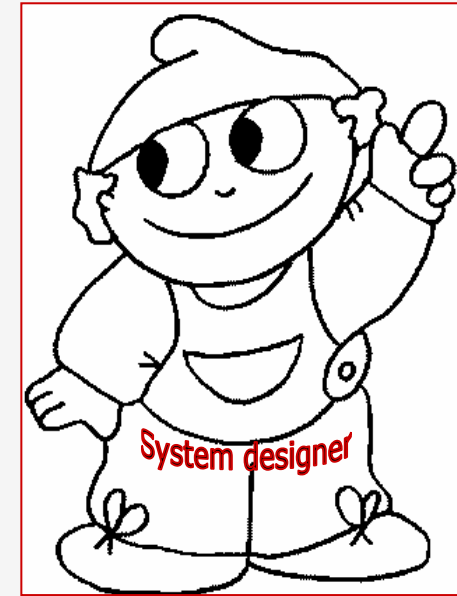
What have emotions to do with updating?
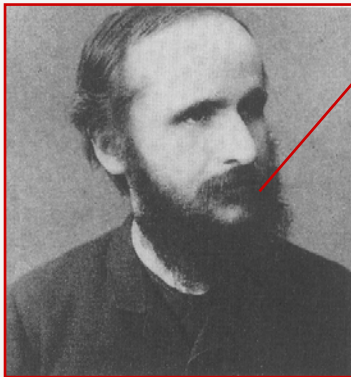
Emotions are reactions to actual or potential **fulfillments and frustrations of desires,** plus in some cases, **confirmations or disconfirmations of beliefs** (e.g., surprise, disappointment).

System designer

These are exactly the points where the BDC and BBC detect match or mismatch – indicating that the belief-desire system might have to be updated!

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Emotions as metarepresentations
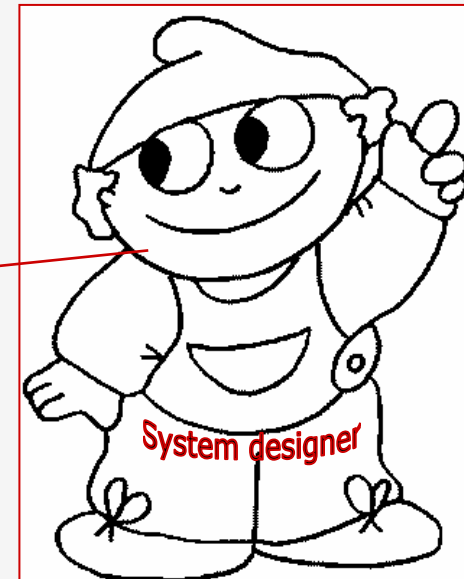
The Belief-Belief Comparator & the Belief-Desire-Comparator

Store for newly acquired beliefs
• **Schroiber wins the election.**

Belief-Belief Comparator (BBC)
→ Belief-Confirmation Signal
→ Belief-Disconfirmation Signal

Belief-Desire Comparator (BDC)
→ Desire-Fulfillment Signal
→ Desire-Frustration Signal

Belief store (preexisting beliefs)
• I will not be invited to Paul's party.
• **Schroiber does not win the election.**
• I won't win a million Euros in the lottery.
• My daughter is sick.
• John does not get what he deserves.
• …

Desire store (preexisting desires)
• I will be invited to Paul's party.
• **Schroiber wins the election.**
• I win a million Euros in the lottery.
• My daughter is not sick.
• John gets what he deserves.
• …

Store for newly acquired beliefs

- **Schroiber wins the election. (s_{new})**

Belief-Belief-Comparator

$s_{new} = s_{old}$?

$s_{new} = \neg s_{old}$?

Belief-Confirmation Signal

Belief-Disconfirmation Signal

Belief store (preexisting beliefs)

- I will not be invited to Paul's party.
- **Schroiber does not win the election.**
- I won't win a million Euros in the lottery.
- My daughter is sick.
- John does not get what he deserves.

...

- **Function**: Compares the content (LOT-sentence) of newly acquired beliefs with the content (LOT-sentence) of existing beliefs

- **Output**: Information about match ($s_{new} = s_{old}$) or mismatch ($s_{new} = \neg s_{old}$) of contents = information about belief-confirmation or belief disconfirmation
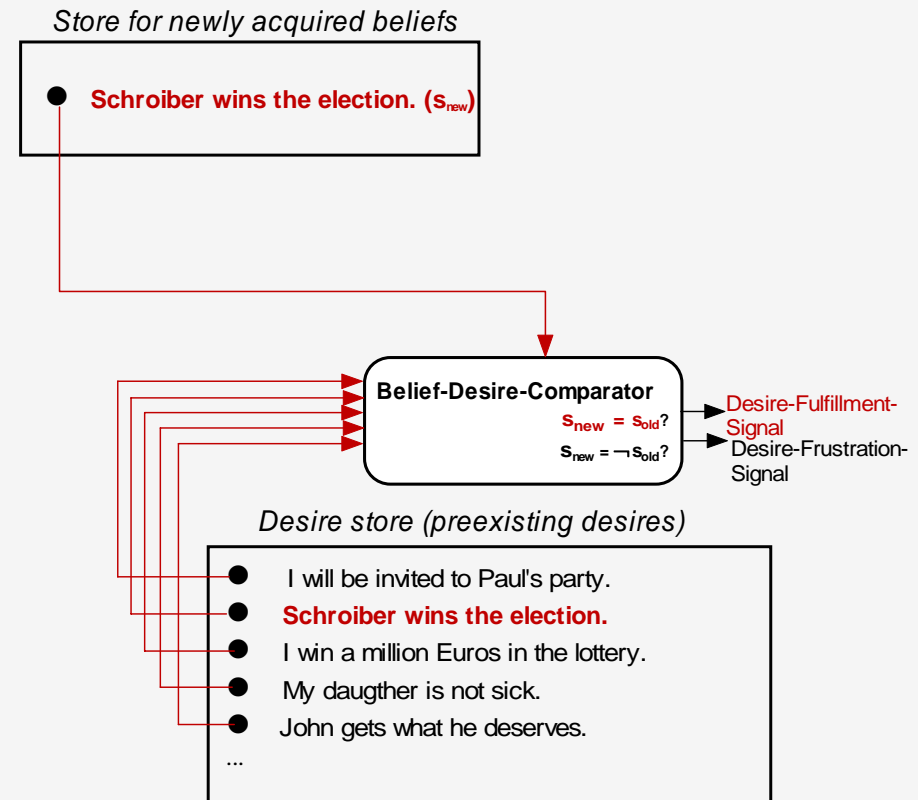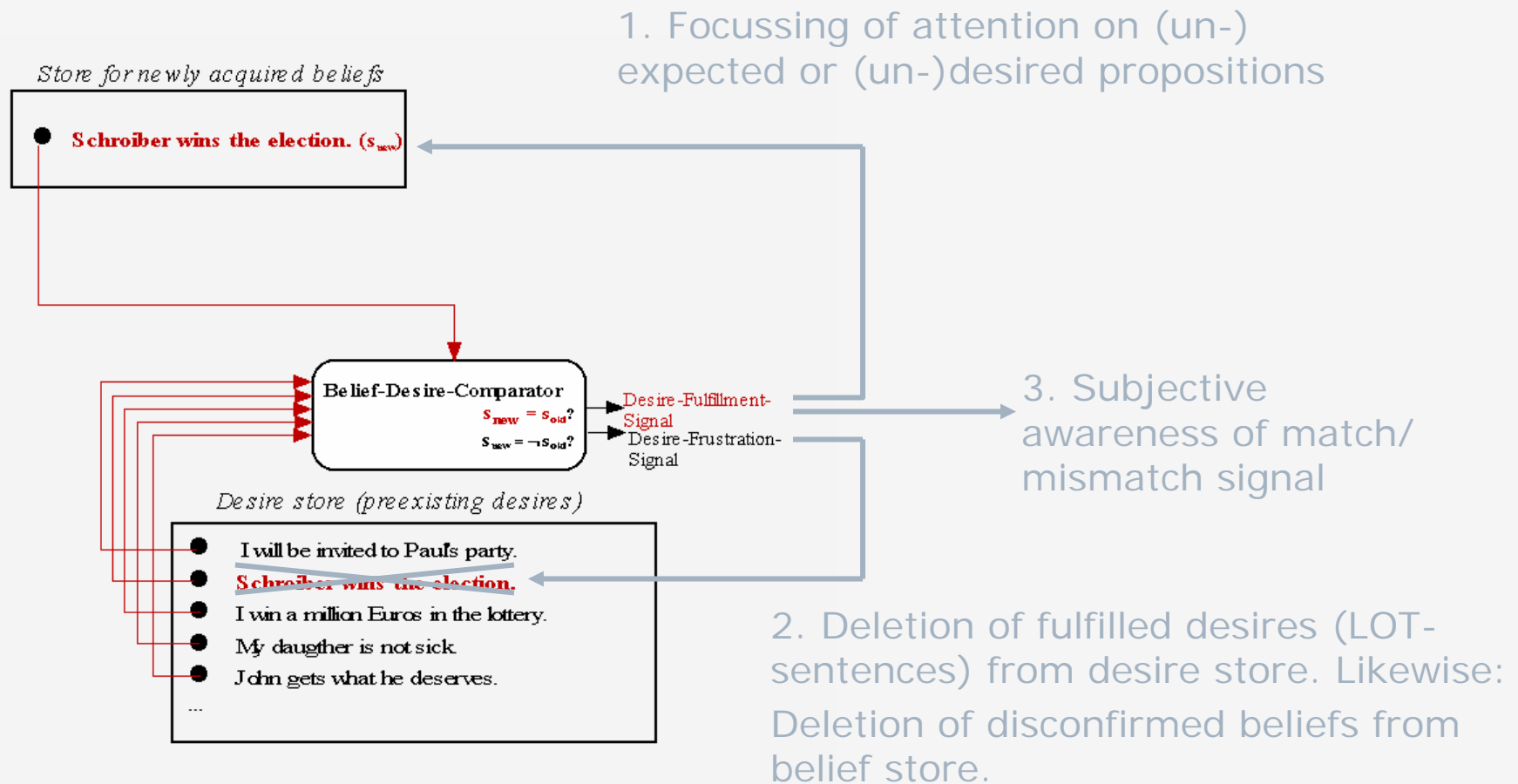
- **Function**: Compares the content (LOT-sentence) of newly acquired beliefs with the content (LOT-sentence) of existing desires

- **Output**: Information about match ($s_{new} = s_{old}$) or mismatch ($s_{new} = \neg s_{old}$) of contents = information about desire-fulfillment or desire frustation

Store for newly acquired beliefs

- **Schroiber wins the election. (s_{new})**

Belief-Desire-Comparator

$s_{new} = s_{old}$?

$s_{new} = \neg s_{old}$?

Desire-Fulfillment-Signal

Desire-Frustration-Signal

Desire store (preexisting desires)

- I will be invited to Paul's party.
- **Schroiber wins the election.**
- I win a million Euros in the lottery.
- My daugther is not sick.
- John gets what he deserves.
- ...

Naturalizing BDTE:
Functional Effects of the BDC and BBC outputs on processing
(here shown for BDC)

1. Focussing of attention on (un-)
expected or (un-)desired propositions

Store for newly acquired beliefs

● **Schroiber wins the election. (s_{new})**

Belief-Desire-Comparator

$s_{new} = s_{old}?$

$s_{new} = \neg s_{old}?$

Desire-Fulfillment-Signal

Desire-Frustration-Signal

Desire store (preexisting desires)

● I will be invited to Paul's party.
● **Schroiber wins the election.**
● I win a million Euros in the lottery.
● My daugther is not sick.
● John gets what he deserves.
...

3. Subjective
awareness of match/
mismatch signal

2. Deletion of fulfilled desires (LOT-sentences) from desire store. Likewise:

Deletion of disconfirmed beliefs from belief store.

Crucial assumption about the comparator mechanisms

- **Implementation**: Hardwired
- **Mode of operation**: Continuous, obligatory, parallel, preconscious
- **Information format of output**: Nonpropositional /nonconceptual (= not a LOT-sentence, but an analog signal that varies in kind and intensity)
    - BBC and BDC are thus in a sense similar to sensory transducers (e. g., sense-organs for color, sound, touch, bodily changes)
    - however, they "sense" the state of the belief-desire-system
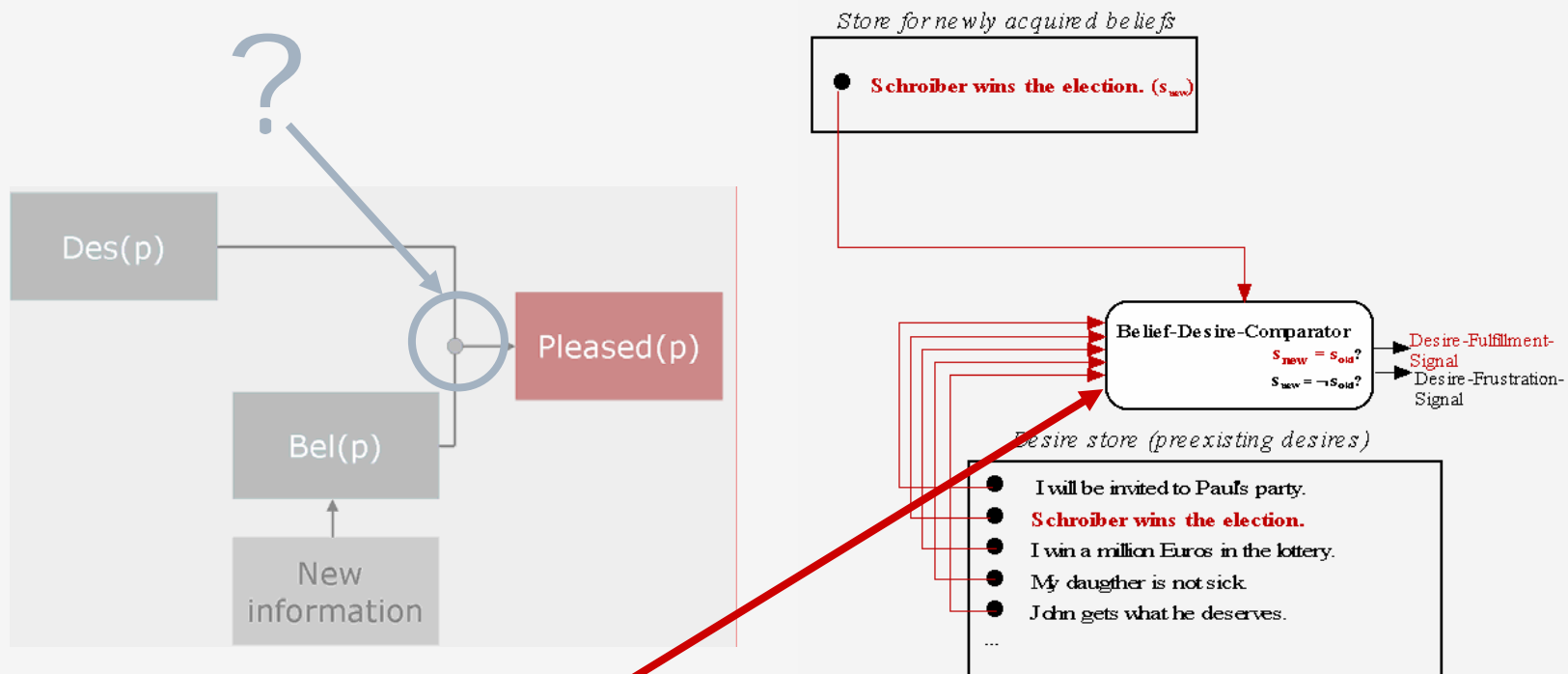
Naturalizing the Belief-Desire Theory of Emotions II

The comparator mechanisms and the emotions: Emotions as nonconceptual metarepresentations
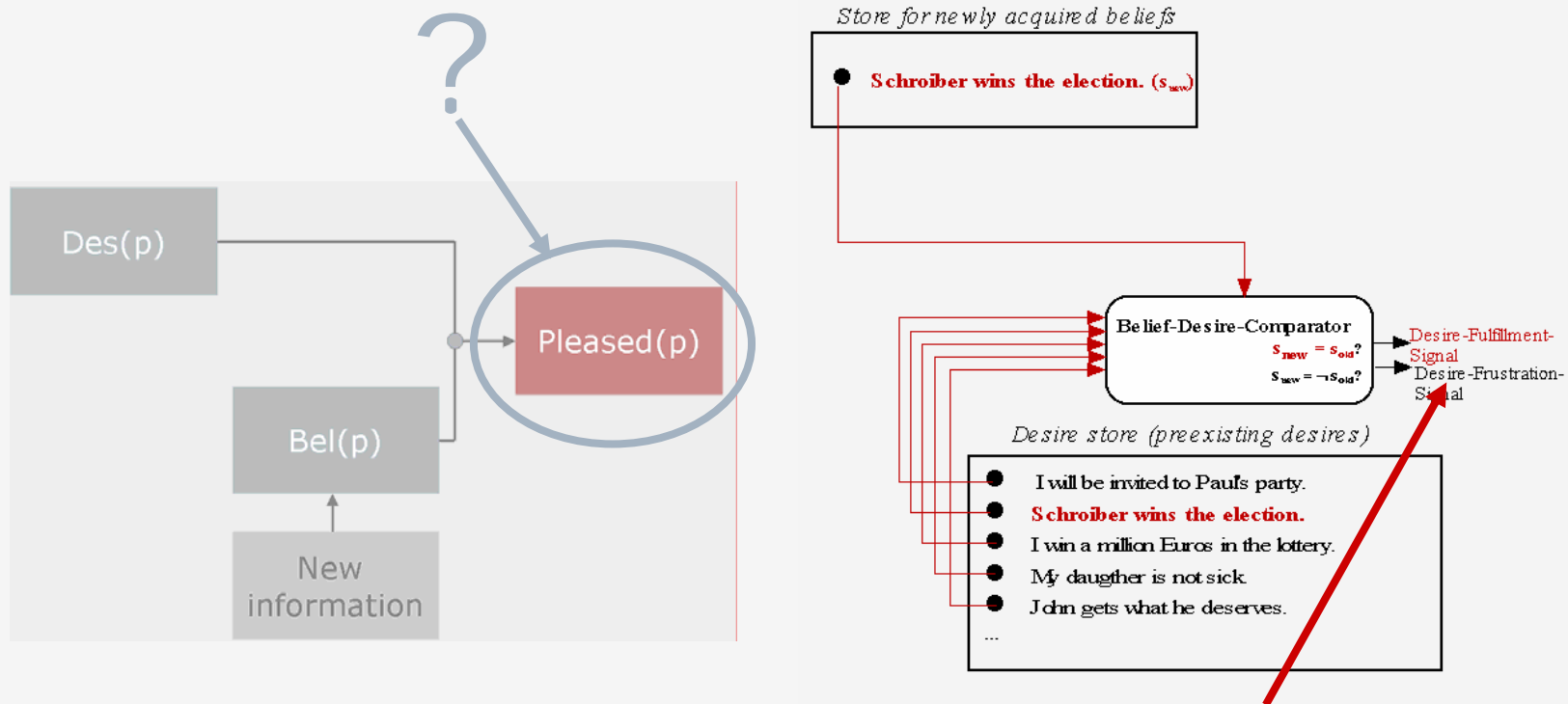
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Emotions as metarepresentations

This is the mechanism (the BDC)
(Analogously for the BBC).
BDC & BBC are the basic emotion
mechanisms.

Store for newly acquired beliefs

● **Schroiber wins the election. (s_{new})**

Belief-Desire-Comparator
$s_{new} = s_{old}$?
$s_{new} = \neg s_{old}$?

Desire-Fulfillment-Signal
Desire-Frustration-Signal

Des(p)

Pleased(p)

Bel(p)

New information

Desire store (preexisting desires)

● I will be invited to Paul's party.
● **Schroiber wins the election.**
● I win a million Euros in the lottery.
● My daugther is not sick.
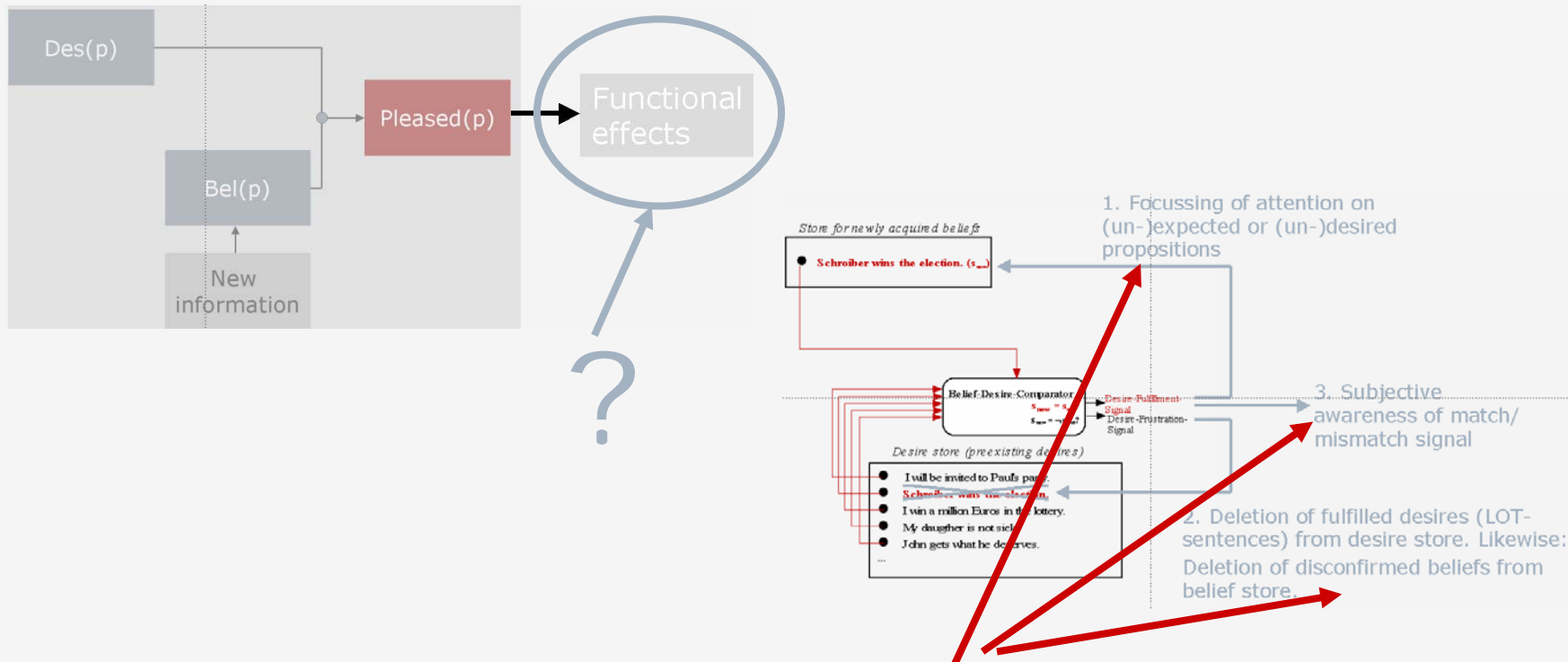● John gets what he deserves.
...

• The emotion (at least its core) is the output (nonpropositional signal of match/ mismatch) of the BDC. Analogously for the BBC.
• Signals are consciously experienced as feelings of pleasure/ displeasure (BDC); expectancy confirmation /surprise (BBC)

The function of emotions (= nonpropositional outputs of the BDC & BBC) is, generally, to assist in the updating of the belief-desire representation system

Why are emotions nonconceptual meta-representations?

- The BDC /BBC outputs carry information about beliefs and desires.

- Assumption: Nonconceptual mental states can be representational states (e.g., Tye, 1996, Dretske, 1995).

- Conclusion: emotions are nonconceptual metarepresentations.

- Emotional experiences represent to the experiencer, in a nonconceptual format, the current state and state changes of his or her belief-desire system (e.g., surprise: "A belief has been disconfirmed"; pleasure: "A desire has been fulfilled")

- Emotional experiences have a broadly cognitive (informational) function--signalling state changes in the belief-desire system. It is useful to have this system information globally available.

Conclusion

"The best thing I can say for [my theory] is, that in writing it, I have almost persuaded myself that it may be true" (p. 205)

—— William James (1884). What is an emotion? *Mind*, *9*, 188-205.

■ **References**

Reisenzein, R. (1998). Outlines of a theory of emotions as metarepresentational states of mind. In In A. H. Fischer (Ed.), ISRE '98. Proceedings of the 10th Conference of the International Society for Research on Emotions, 1998 (pp. 186-191). Amsterdam: Faculty of Psychology.

Reisenzein, R. (1999). A theory of emotions as metarepresentational states of mind. Unpublished manuscript (available from author on request).

Reisenzein, R. (2001). Appraisal processes conceptualized from a schema-theoretic perspective: Contributions to a process analysis of emotions. In K. R. Scherer, A. Schorr, & T. Johnstone (Eds.), Appraisal processes in emotion: Theory, methods, research. Oxford: Oxford University Press.

Arguments for the theory

An argument from design

Explanatory capacity of the theory

- 1. BBCs and BDCs of some form are needed (without them, the belief-desire system could not work).

- 2. At issue is therefore only their special form.

- 3. Only alternative that seems to have been proposed: BBCs and BDCs are ordinary propositional inference processes ("metapropositional theory")

  - The person forms a belief (metacognition) about match or mismatch of newly acquired beliefs with preexisting beliefs and desires, e.g.:

  - Belief about belief disconfirmation (BBC): Bel[Bel(p,t) & Bel($\neg$p, t-1)] $\Rightarrow$ Bel[Bel($\neg$p, t-1) is disconfirmed,t]

  - Belief about desire fulfillment: Bel[Bel(p,t) & Des(p, t)] $\Rightarrow$ Bel[Des(p, t) is fulfilled, t]

- 4. This theory is implausible. „Metapropositional" inferences are:
  - Too complex $\rightarrow$ unlikely to be present in children and animals that we would like to ascribe propositional emotions
  - Implausible from an evolutionary perspective (BD system must be equipped with BBCs and BDCs from the start)
  - Gets the object-directedness of emotions wrong: E.g. one is surprised that p, not that Bel($\neg$ p) is disconfirmed or that p is unexpected.
- 5. Present theory avoids these problems
- 6. It is hard to think of another alternative that is significantly different from both the „metapropositional" theory and the present account.

Arguments for the Theory: II. Explanatory Capacity

- 1. Theory explains what is distinctive about the phenomal aspect of emotional experiences as well as, or better than, any other existing theory.

- 2. Theory provides for a principled demarcation of basic emotional feelings.

- 3. Theory (re-)solves the "intentionality puzzle" of emotions.

- 4. Theory (re-)solves the "cognition-emotion debate" in psychology.

- 5. There is some indirect empirical evidence for the proposed mechanisms
    - evidence for automaticity of belief-desire comparisons; Moors & DeHouwer, 2001; Moors, 2004)
    - Evidence that people use pleasure /displeasure feelings (e.g., Schwarz & Clore, 1996), as well as feelings of surprise, as information when making inferences (e.g., Reisenzein & Studtmann, 2005)