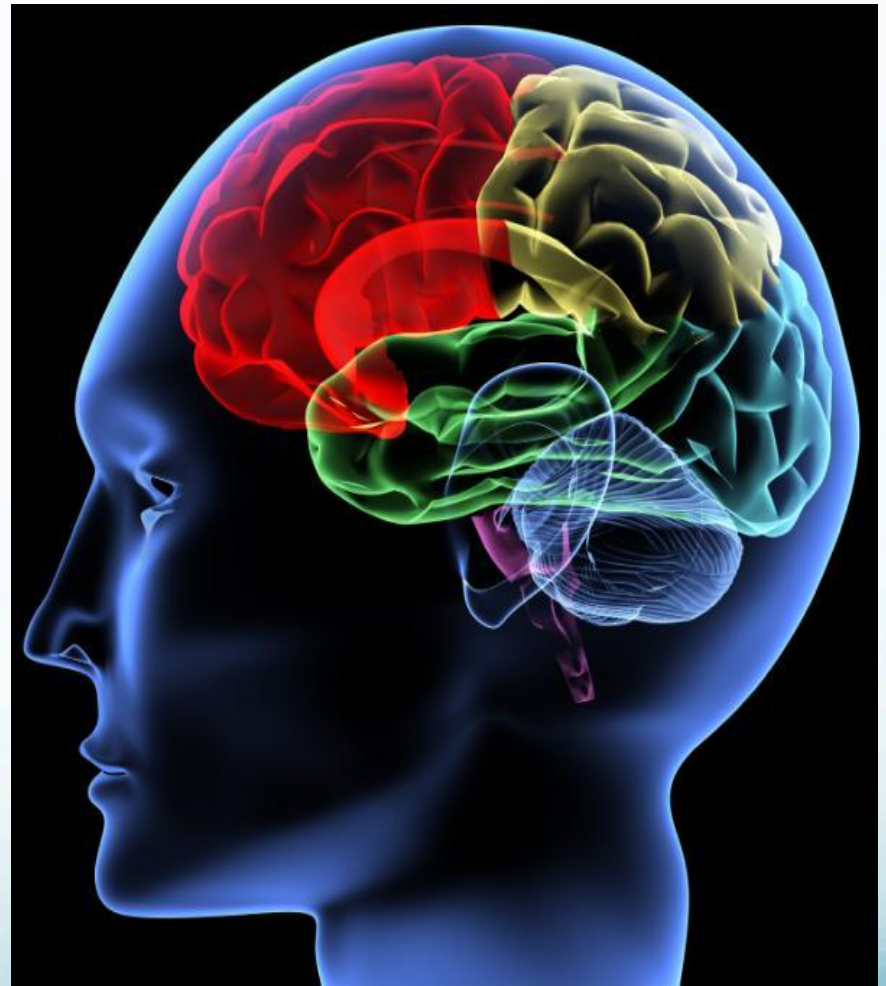# Relevant Emotions

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1

Outline

1. Relevance
2. Semantic pointers
3. Emotion
4. Epistemic emotions, e.g. interest

What is Relevance?
3-analysis

Exemplars: work, life, law

Typical features: topic or question, person or group, connection between topic and person, goals

Explains: decisions, actions, attention, language, inferences

Explained by: ?

Concepts are Semantic Pointers: Blouw, Solodkin, Thagard, and Eliasmith, 2016, *Cognitive Science.*

Legal Relevance

Common law, e.g. USA, court objections.

Evidence is relevant if:

(a) it has any tendency to make a fact more or less probable than it would be without the evidence; and

(b) the fact is of consequence in determining the action
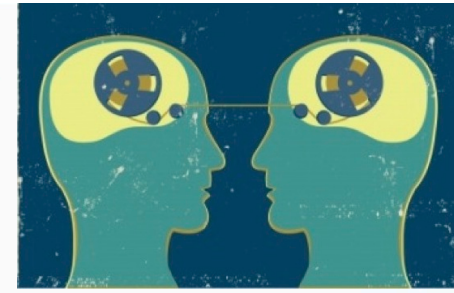
Problems: probability, consequence

Relevance Logic

In propositional logic, *if p then q* is true if *p* is false, e.g. if Helsinki is in Sweden, then Thagard is Chinese.

Solution: require some relevant connection between p and q.

Semantics: possible worlds.

Problems: connection not specified, possible worlds remote from human thought.

5

Psycholinguistics

Grice's maxim of relevance: expect a partner's contribution to be appropriate to immediate needs at each stage of the transaction.

Sperber & Wilson, Relevance Theory:

1. Stimulus is relevant enough for it to be worth the addressee's effort to process it.
2. Stimulus is the most relevant one compatible with the communicator's abilities and preferences.

Relevance and Emotion

Problem: how does the mind/brain judge relevance?

Hypothesis: Relevance judgments are typically emotional.

Positive: interesting, surprising …

Negative: boring, confusing, annoying …

Theories of Emotion

1. Emotion is a property of non-material souls.

2. Emotion is cognitive appraisal (Nussbaum, Ortony, Scherer, etc.).

3. Emotion is physiological perception & embodiment (James, Damasio, Prinz, Niedenthal, etc.).

4. Emotion is social/linguistic construction (Harre, etc.).

5. Emotions are Semantic Pointers

Emotion = bind (concept or belief, cognitive appraisal, physiological perception)

Example: being happy to be in Finland = bind (Finland, appraisal, physiology)

Concepts, beliefs, appraisal, and physiology are all patterns of neural firing.

Binding is by convolution as performed in the Semantic Pointer Architecture.

Thagard and Schröder, Emotions as Semantic Pointers, 2014.

The New Synthesis

Thesis (1950s):   Intelligence results from the processing of physical symbols. (Herbert Simon, traditional AI)

Antithesis (1980s): Intelligence results from sub-symbolic processes in neural networks, operating with distributed representations.

Synthesis: Neural networks are capable of symbolic processes, using semantic pointers.

Chris Eliasmith: *How to Build a Brain*, Oxford U. Press, 2013. Eliasmith et al. (2012), *Science*.

10

Representation and Binding

Representation: pattern of firing in population of neurons

Synchrony: neurons fire in temporal coordination
    Syntax: e.g. Shastri, Hummel
    Consciousness: e.g. Crick, Engel, Scherer

Convolution: activity of neural populations becomes "twisted together": convolve.

Representations are braided together.

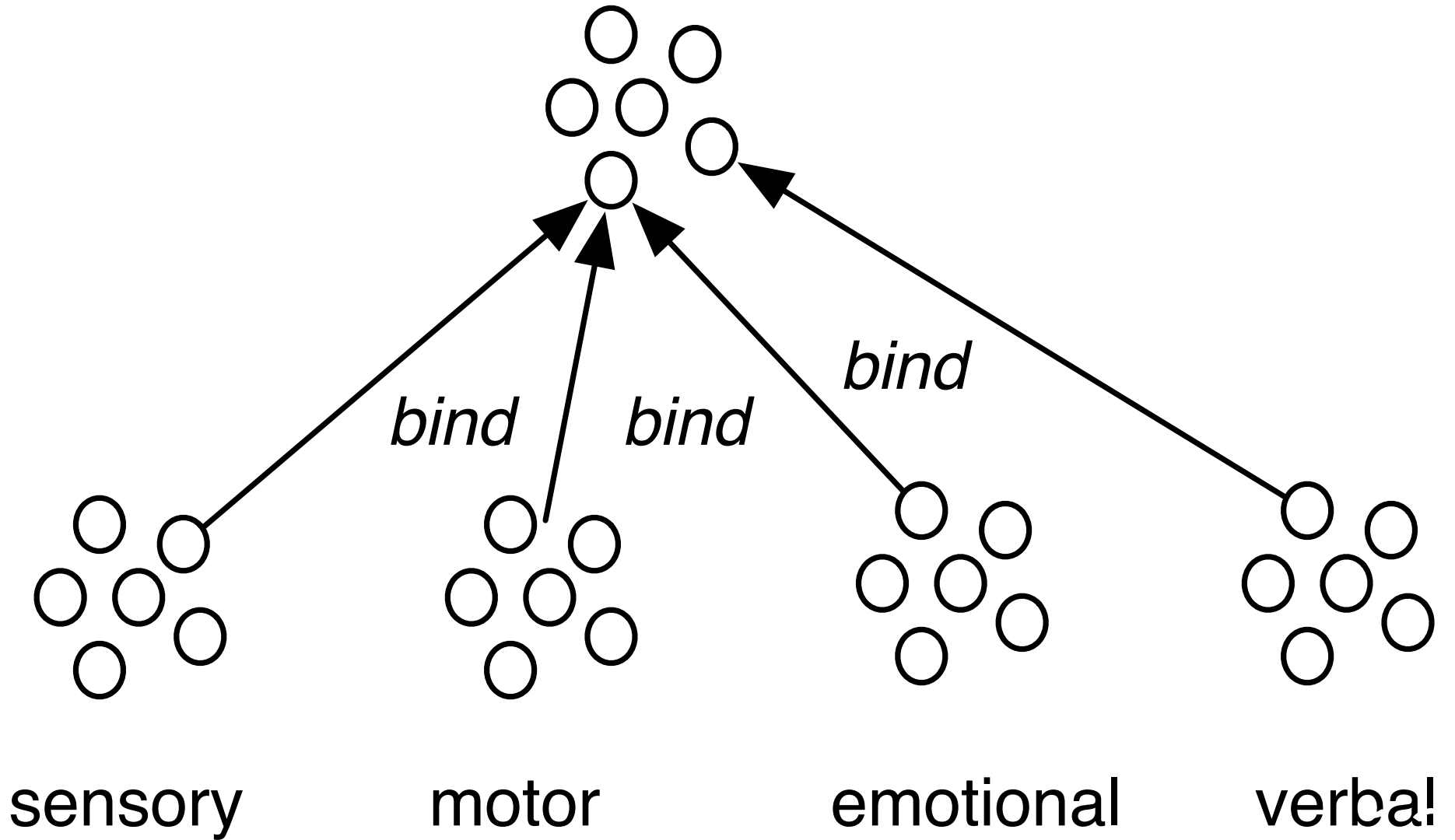Eliasmith has shown how neural populations can perform convolution.

Semantic Pointers (Eliasmith 2013)

Semantic pointers are patterns of neural firing that:

1. provide *shallow meaning* through symbol-like relations to the world and other representations;

2. expand to provide *deeper meaning* with relations to perceptual, motor, and emotional information;

3. support complex syntactic operations;

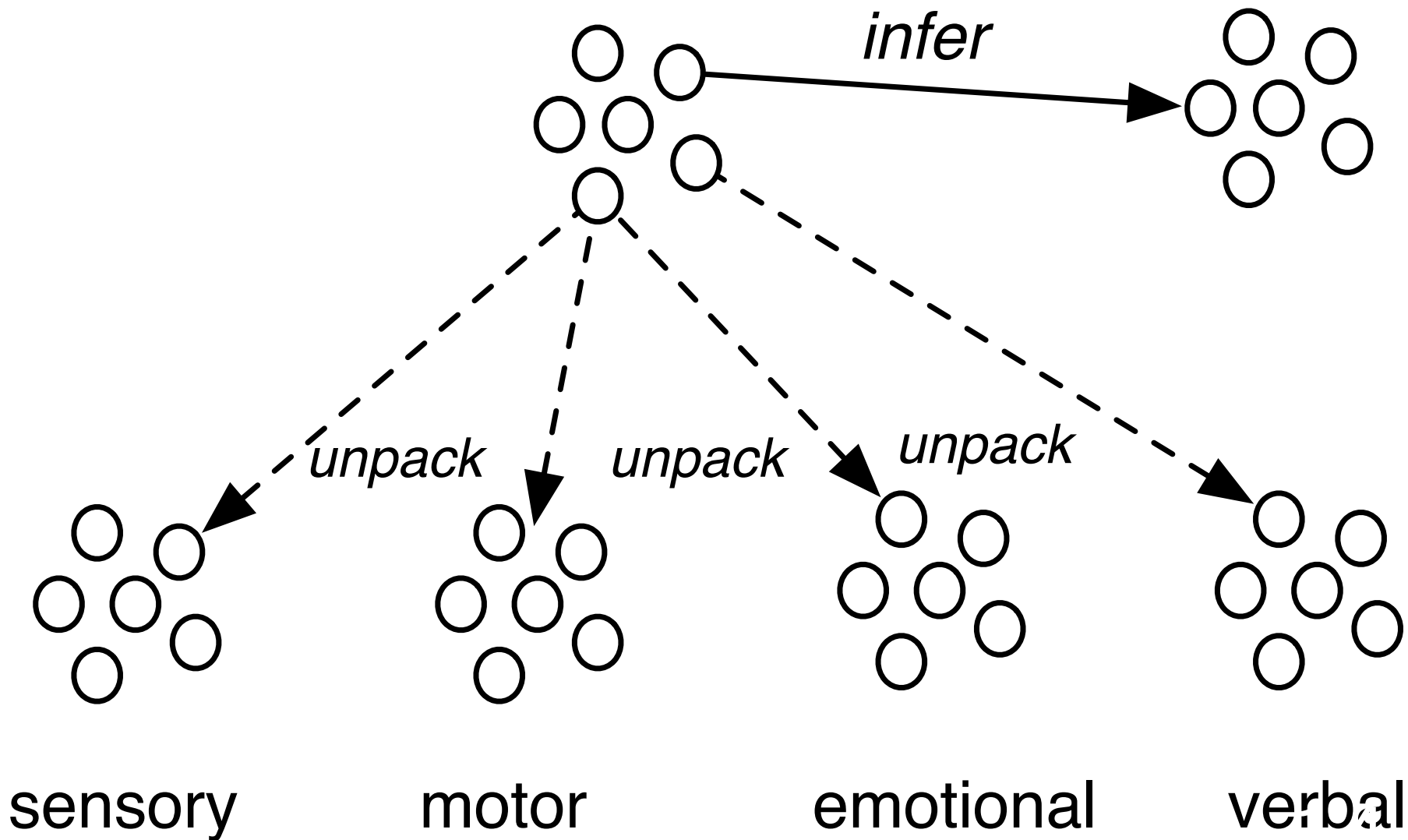4. help to control the flow of information through a cognitive system to accomplish its goals.
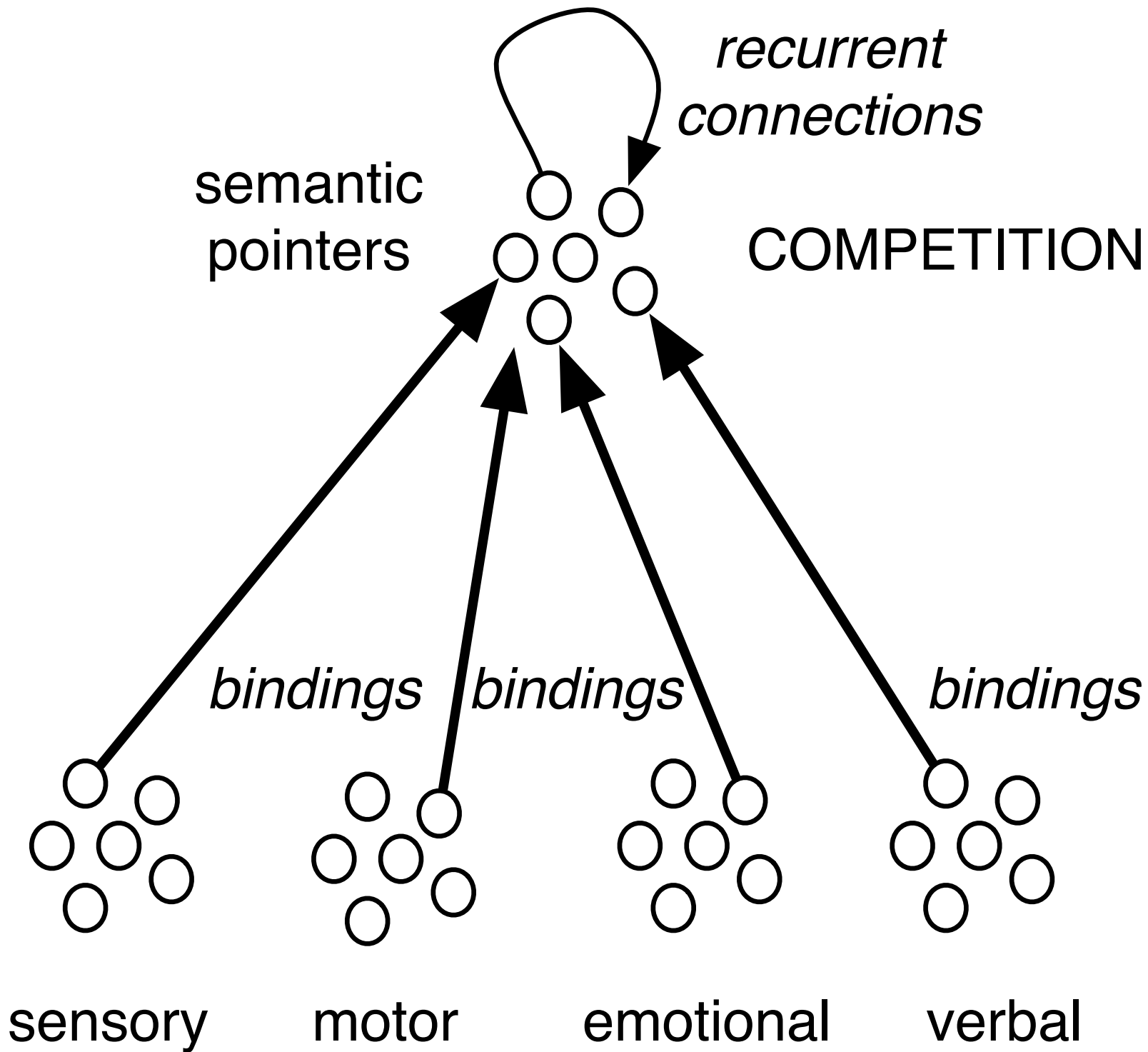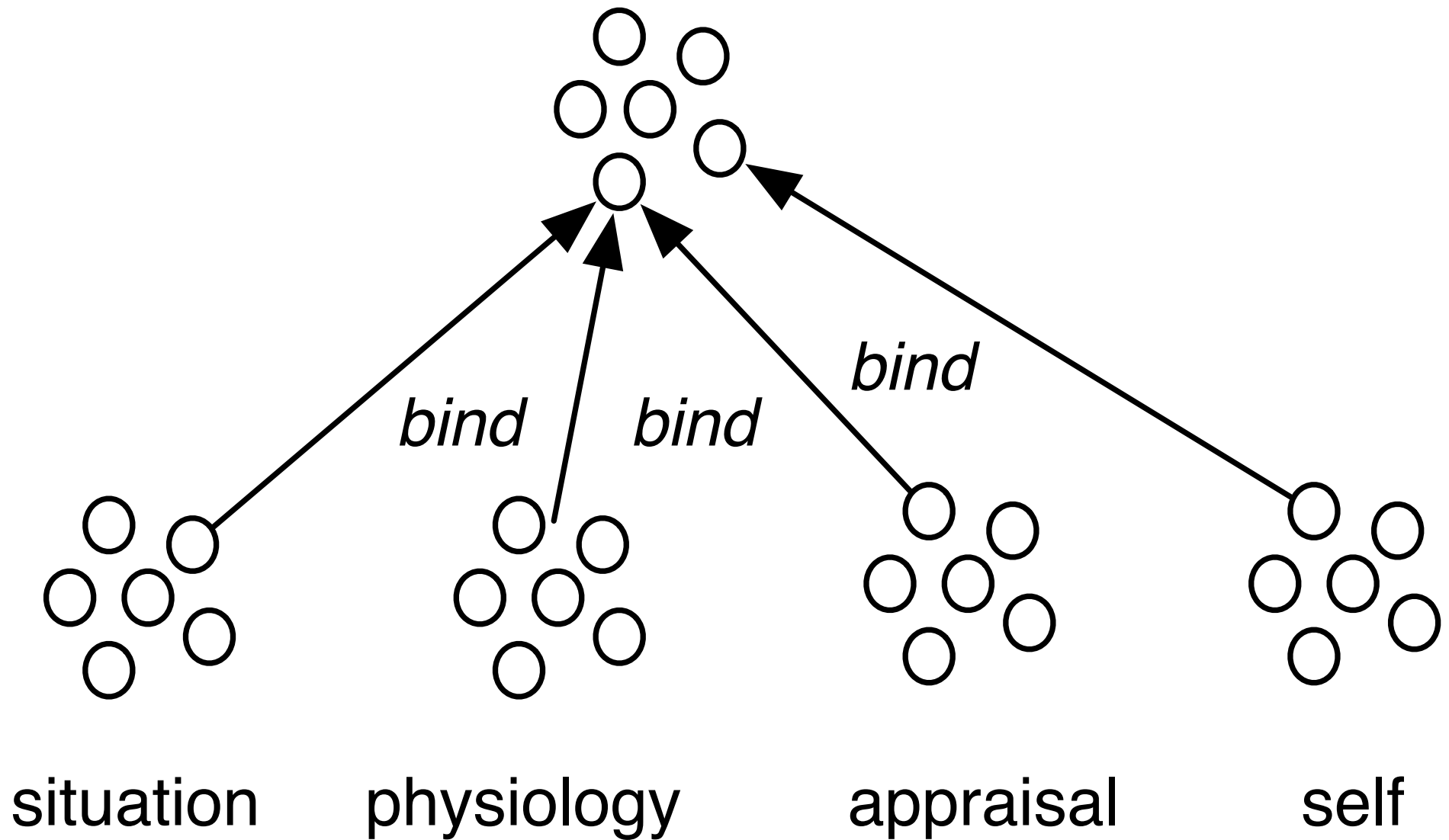
12

FORMATION

semantic pointer

FUNCTION

semantic pointer
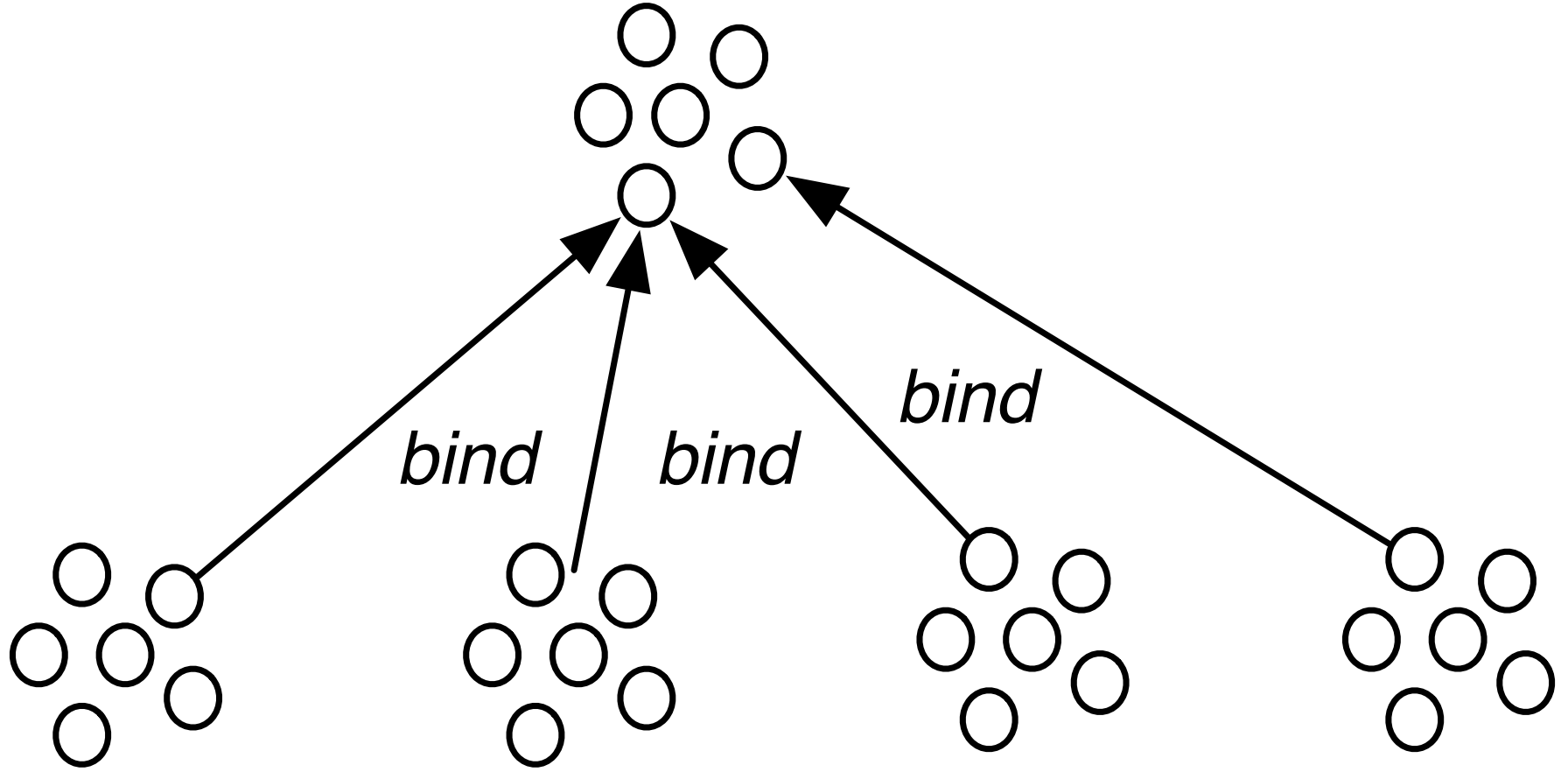

infer

unpack   *unpack*   *unpack*

sensory   motor   emotional   verbal

recurrent
connections

semantic
pointers

COMPETITION

bindings   bindings   bindings

sensory   motor   emotional   verbal

15

emotion semantic pointer

bind   bind   bind

situation   physiology   appraisal   self

sadness
semantic pointer

bind   *bind*   *bind*

situation:
rejection:
sensory, verbal

appraisal:
e.g. no
relationship

physiology:
low heart rate,
etc.

motor
withdra...

Cognitive Appraisal

Appraisal is performed by parallel constraint satisfaction that integrates relevance of multiple goals. Thagard & Aubie, Emotional Consciousness, 2008.

Fast & frugal appraisal can employ emotional associations of words.

Appraisal in humans can take into account complex representations of self and social situation. Thagard, The Self as a System of Multilevel Mechanisms, 2014.

18

Emotional Consciousness

Emotions are usually conscious because they outcompete other semantic pointers.

Emotional intensity contributes to the salience of semantic pointers: appraisal, physiology, language.

Conscious emotions can influence actions because they can outcompete automatic actions.

Epistemic Emotions

Emotions are crucial to actions, including decisions about how to pursue knowledge, e.g. The Passionate Scientist
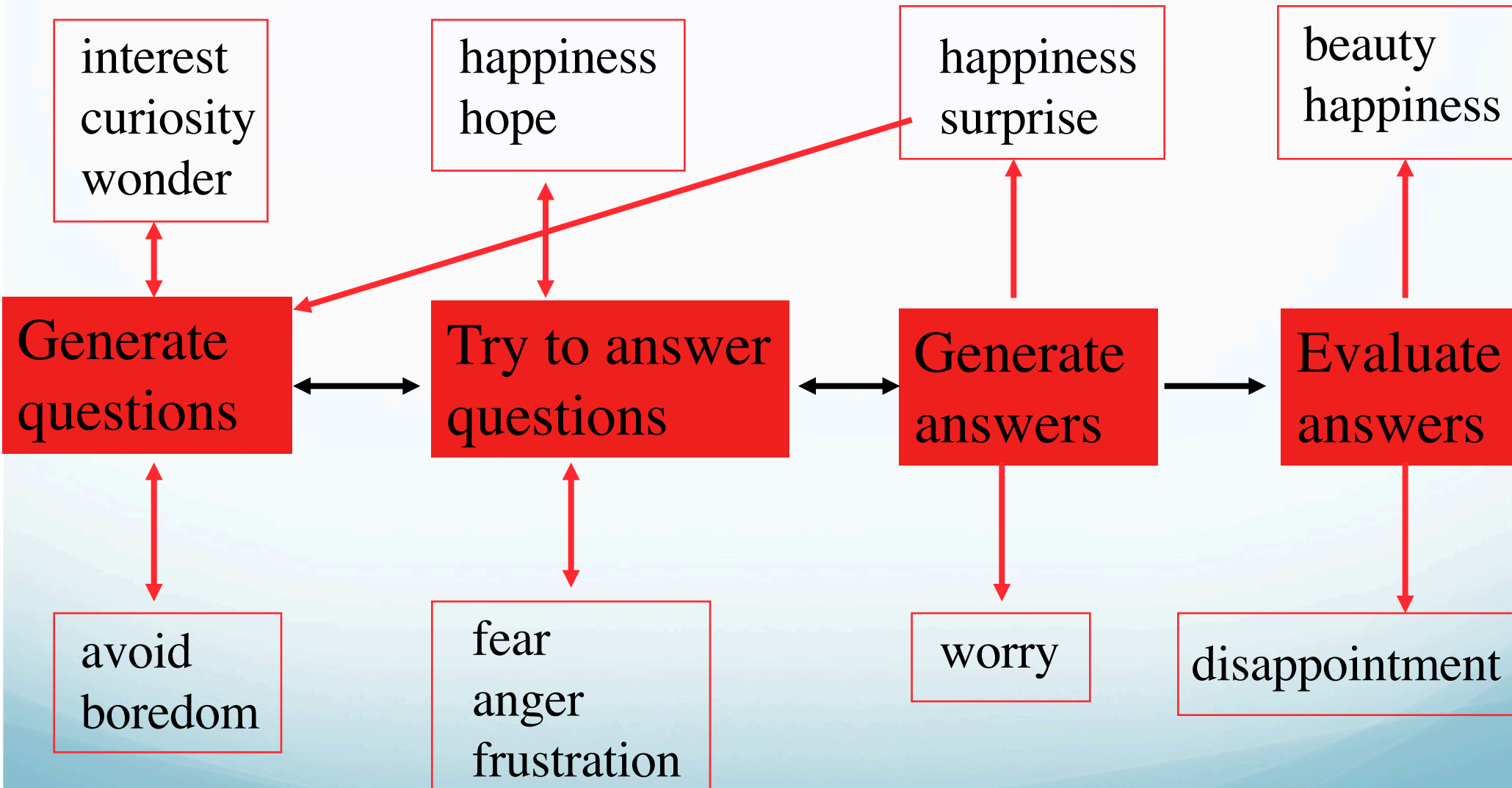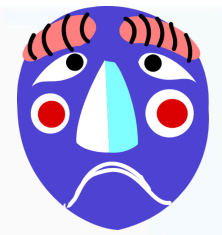
Positive: interest, intrigue, curious, exciting, enjoyable, surprising, wonder ...

Negative: boring, annoying, dull, confusing, frustrating, disappoint ...

Bind: object, appraisal, physiology

Emotions in Scientific Thinking

interest
curiosity
wonder

happiness
hope

happiness
surprise

beauty
happiness

Generate questions

Try to answer questions

Generate answers

Evaluate answers

avoid boredom

fear
anger
frustration

worry

disappointment

Interest

Object: question, topic, fact, hypothesis

Appraisal: object fits with goals such as learning, problem solving, and action: emotional coherence

Physiology: facial expression, body language, dopamine, arousal

Competition: outcompetes others

22

Boredom

Object: question, topic, fact, hypothesis

Appraisal: object does not fit with goals such as learning, problem solving, and action: emotional coherence

Physiology: facial expression, body language, low arousal -> arouse action

Competition: easily outcompeted, e.g. daydreaming

23

Conclusions

1. Relevance is usually based on emotional coherence with goals.

2. Emotions are semantic pointers – brain processes.

3. Epistemic emotions are important for relevance in education and creativity.

24