

emotions of another agent.

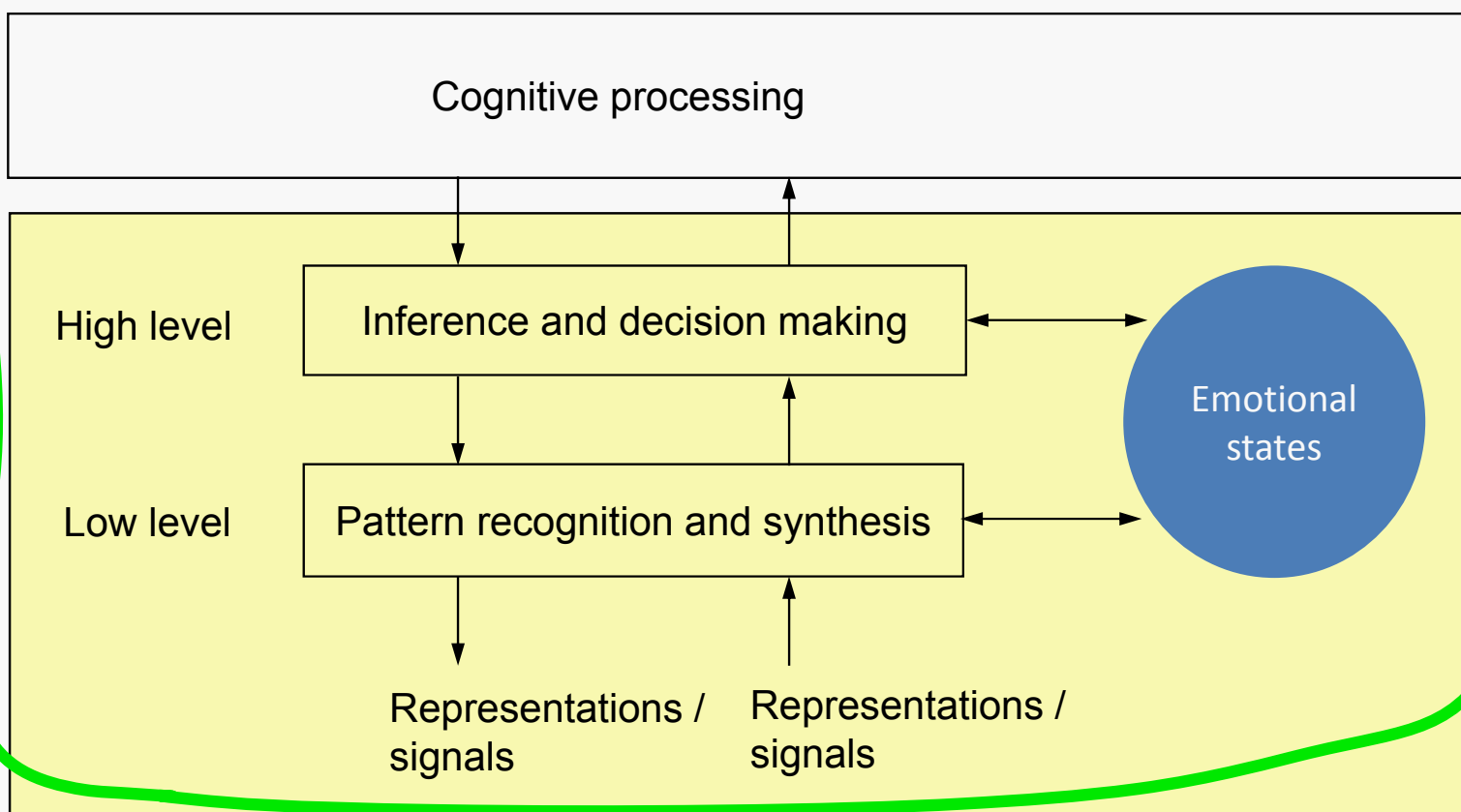
- Animosity. An agent will tend to have oppositely valenced emotions in response to the emotions of another agent
- Empathy. An agent will temporarily substitute the presumed goals, standards, and preferences of another agent for its own. It will then synthesize emotions based on these presumed goals, standards and preferences, in an effort to feel what it thinks the other agent would feel.

[Picard 1997]

#1

p. 9

Affective Computing



[Picard 1997]

#2

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Applications of affective computing

- Affective mirror
- Beyond emoticons
- Text to speech
- Helping autistic people
- Consumer feedback
- Points for courage
- Emotions in learning
- "No pain, no gain"
- Classroom barometer
- Emotions on the virtual stage
- Music: listening to what you like
- "Fast forward to the interesting part"
- Agents that learn your preferences
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- The audience performance
- Film/video
- Sensitive toys

[Picard 1997]

#3

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5. Cognitive and Affective Computing

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Kyoto University

Studies on conversational interactions

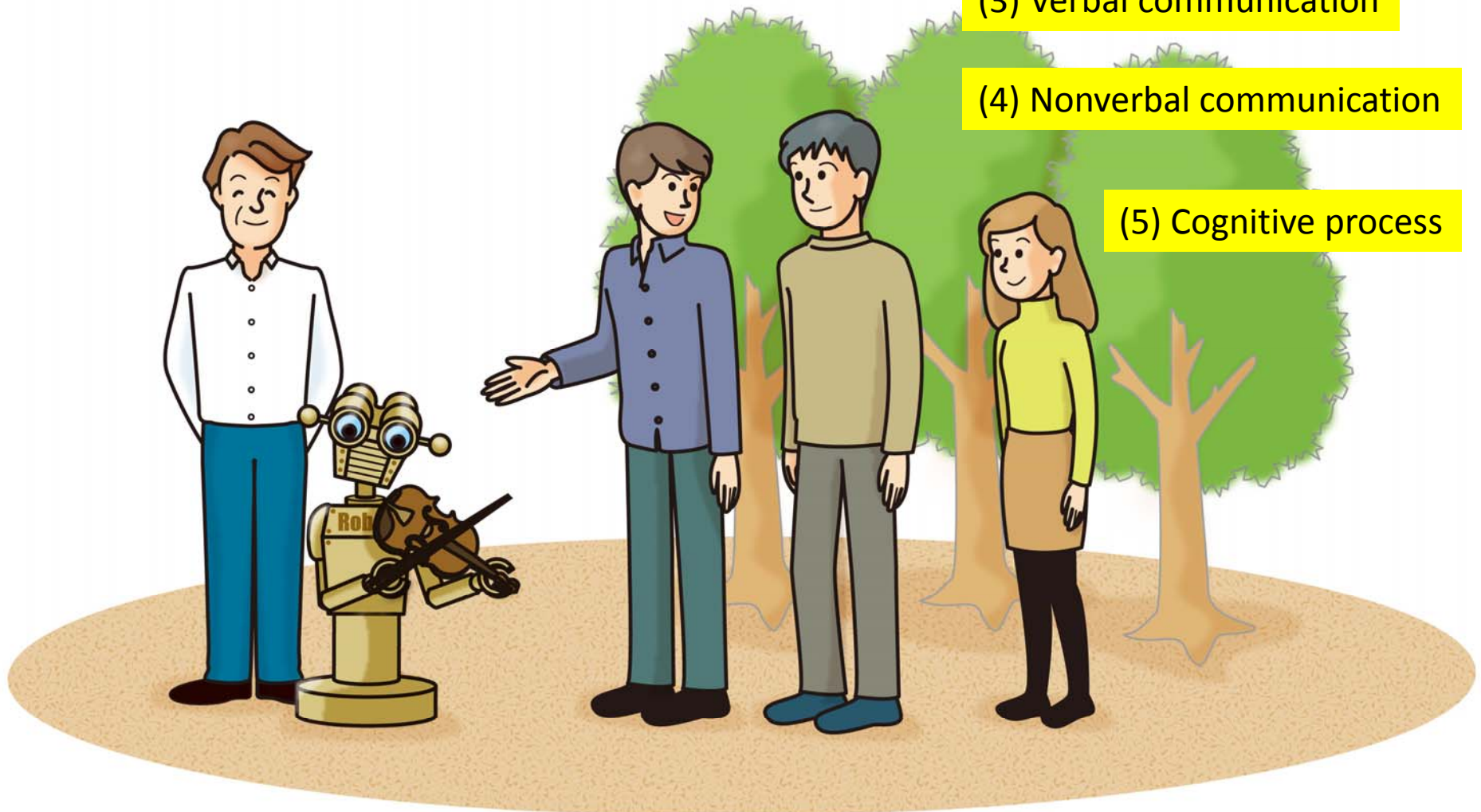
(1) Narratives and content flow

(2) Social discourse

(3) Verbal communication

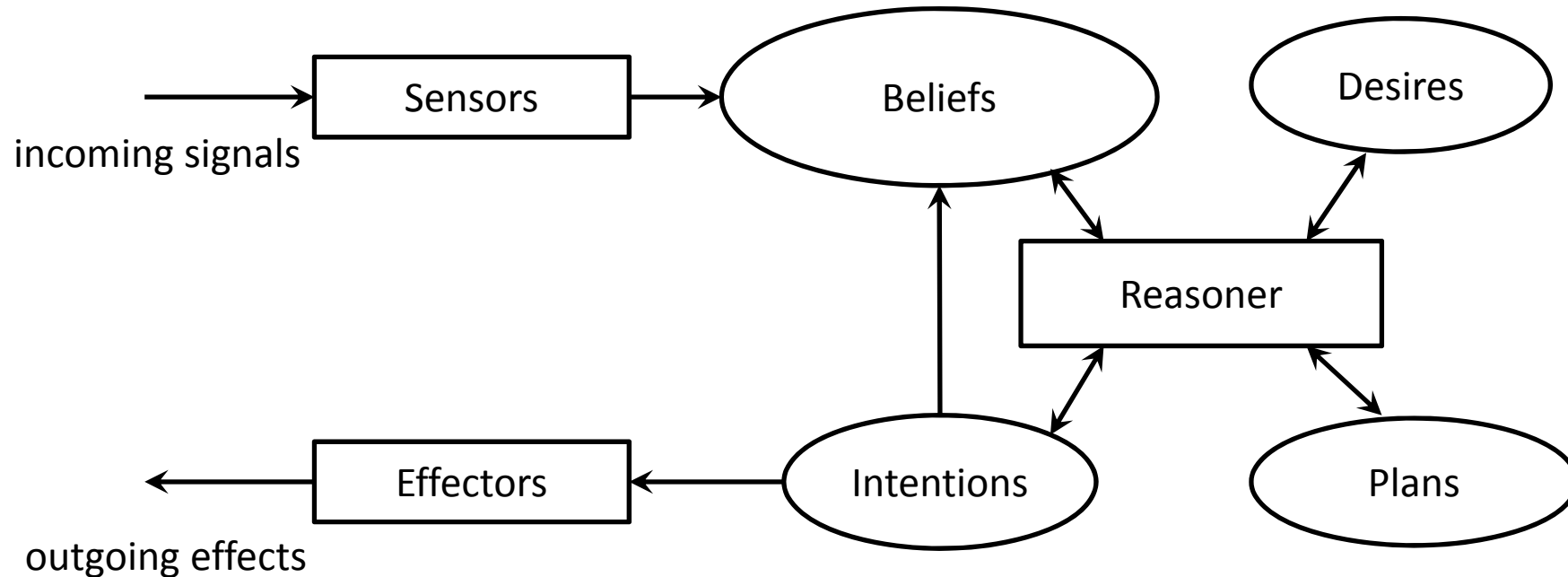
(4) Nonverbal communication

(5) Cognitive process



Cognitive Computing

BDI-architecture



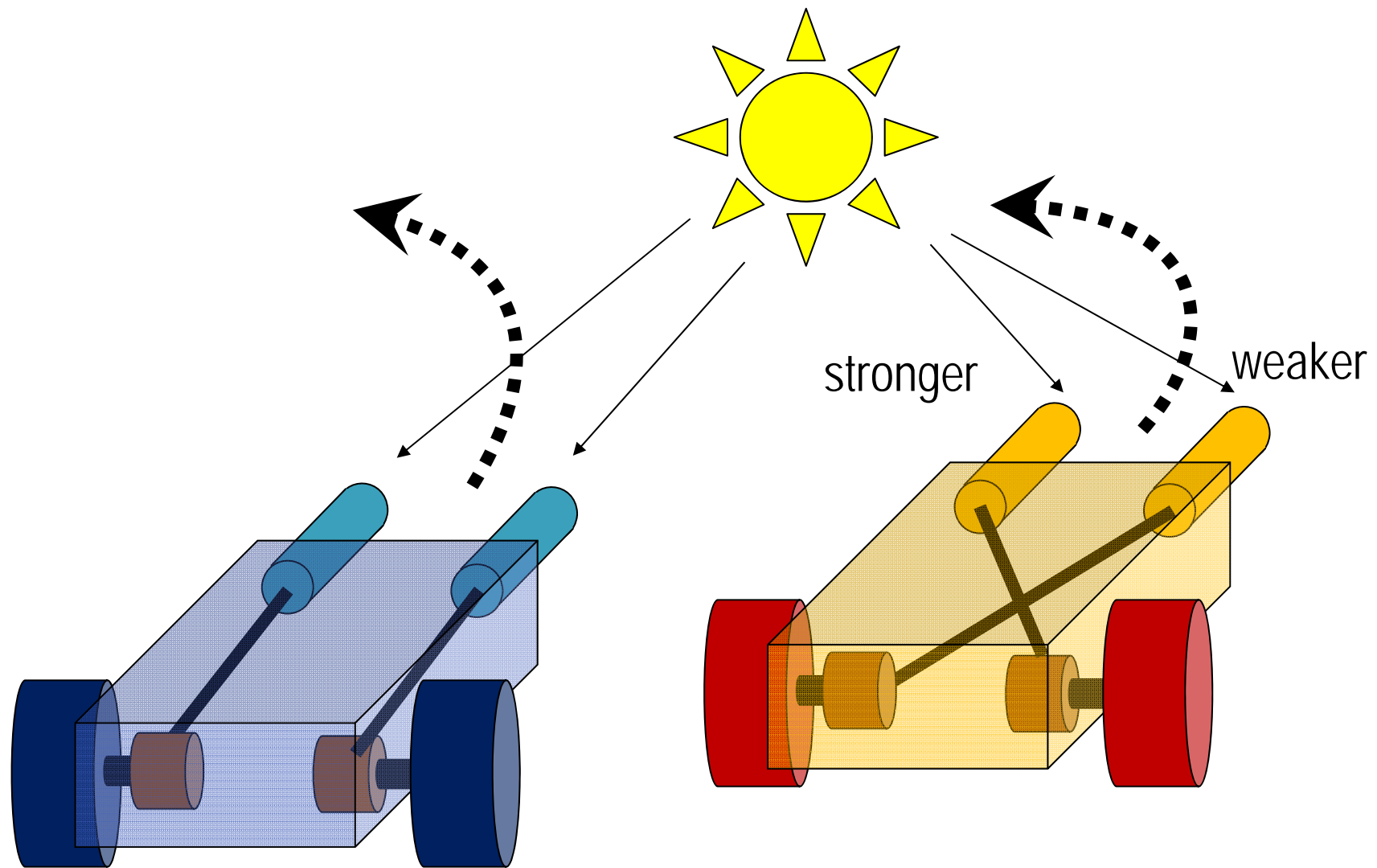
[BDI] does not provide any theoretical ground to answer question such as: What should be an agent's desires (and why)? Why should one desire be preferred over another? [Lim 2010]

The question is not whether intelligent machines can have any emotions, but whether machines can be intelligent without any emotions" (Minsky: Society of Mind).

Deeper source of behaviors ➡ Affective computing

[Georgeff 1990]

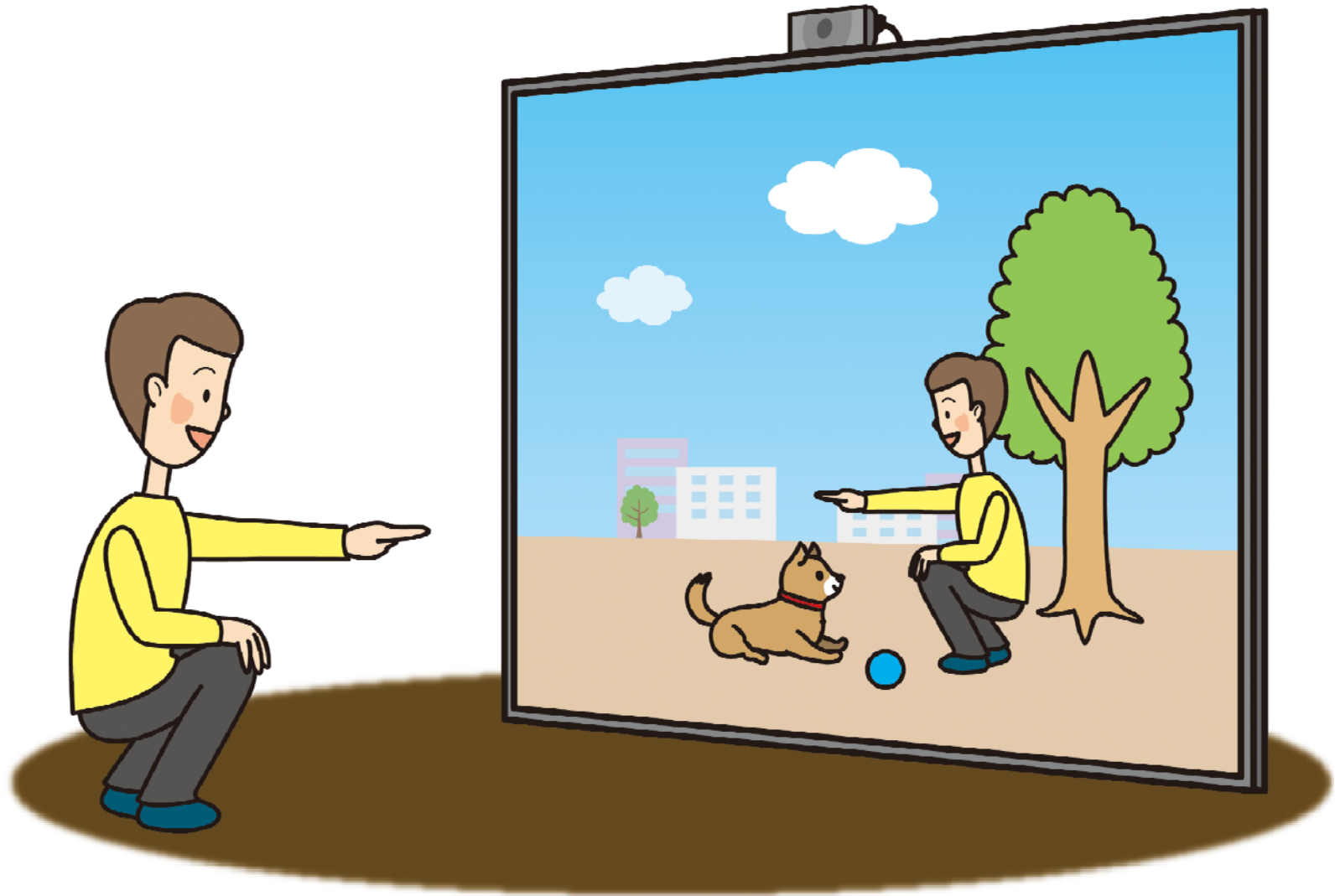
The Braitenberg's “emotional” vehicles



The vehicle on the left may appear to fear the light, while that on the right may appear as if it liked the light.

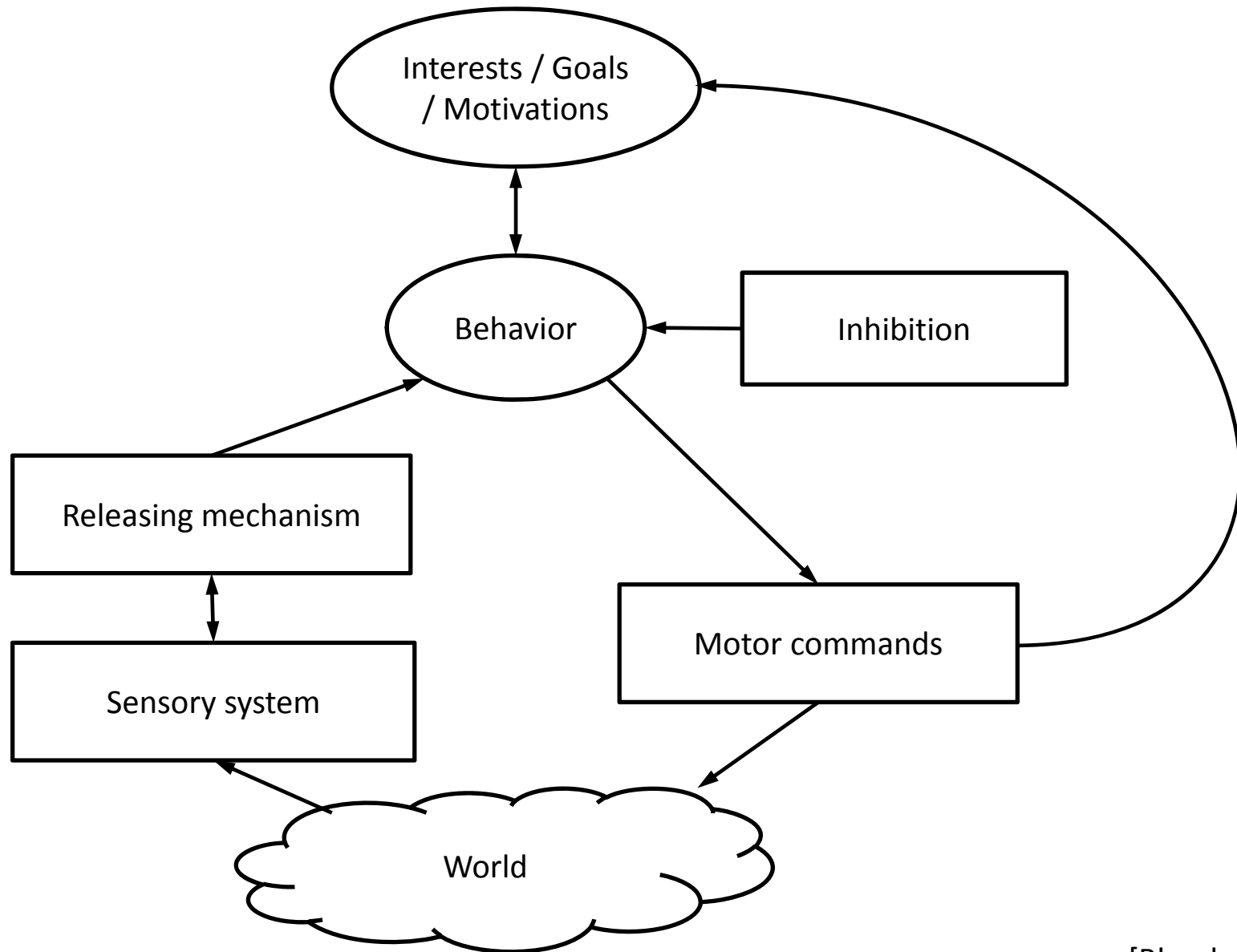
[Braitenberg 1984]

ALIVE



[Maes 1995; Nishida et al 2014]

Silas the dog



[Blumberg 1997]

Computers that “have” emotions

- Emergent emotions and emotional behavior
 - Attributed to systems based on their observable emotional behaviors
- Fast primary emotions
 - Innate, quick and dirty reactions
 - Include at least fear, surprise, and anger
- Cognitively generated emotions
 - Explicit reasoning is typically involved in their generation.
 - “Don’t worry; be happy”
 - Reason about emotions (e.g., using the Ortony Clore Collins model)
- Emotional experience
 - The ability to be cognitively aware of its emotional state. It consists of cognitive awareness, physiological awareness, and subjective feelings.
- Body-mind interactions
 - Emotions influence memory and memory retrieval, cognition and decision making.
 - Cognitive thoughts, which include concerns, goals, and motivations, can generate emotions.

The OCC (Ortony, Clore, Collins) Model

Consequences of events	[+]	Consequences for others	Desirable for other		“pleased”	
			Undesirable for other		“happy-for”	
		Consequences for self	Prospects relevant	Confirmed	“gloating”	
				Disconfirmed	“hope”	
			Prospects irrelevant	Attributed to self (agent)		“satisfaction”
				Attributed to others		“relief”
						“joy”
						“gratification”
	[-]	Consequences for others	Desirable for other		“gratitude”	
			Undesirable for other		“displeased”	
		Consequences for self	Prospects relevant	Confirmed	“resentment”	
				Disconfirmed	“pity”	
			Prospects irrelevant	Attributed to self (agent)		“fear”
				Attributed to others		“fears-confirmed”
						“disappointment”
						“distress”

Actions of agents	[+]			“approving”
		Focusing on self agent		“pride”
		Focusing on other agent		“admiration”
	[-]			“disapproving”
		Focusing on self agent		“shame”
		Focusing on other agent		“reproach”

Aspects of Objects	[+]			“liking”
		Attraction		“love”
	[-]			“disliking”
		Attraction		“hate”

[Ortony 1988]

The Affective Reasoner

The Affective Reasoner by Clark Elliott demonstrates how modeling personalities of agents and their social relationships can interact with the generation of emotions.

Model of personality

- How events, acts, and objects are interpreted with respect to an individual agent's goals, standards, and preferences.
- How an agent will act or feel in response to an emotional state.

Model of social relationships and their influences on emotions

- Friendship. An agent will tend to have similarity valenced emotions in response to the emotions of another agent.
- Animosity. An agent will tend to have oppositely valenced emotions in response to the emotions of another agent.
- Empathy. An agent will temporarily substitute the presumed goals, standards, and preferences of another agent for its own. It will then synthesize emotions based on these presumed goals, standards and preferences, in an effort to feel what it thinks the other agent would feel.

The Affective Reasoner

(The agent has previously learned that the word “Ruth” is a female friend of the user)

...

User: “Ruth is unhappy”

Agent: “I am sorry to hear that. You must feel sorry for her.”

(days later)

Agent: “How is Ruth?”

User: “Ruth is jealous of her rival.”

Agent: “How much is Ruth feeling this resentment?”

User: “Very much.”

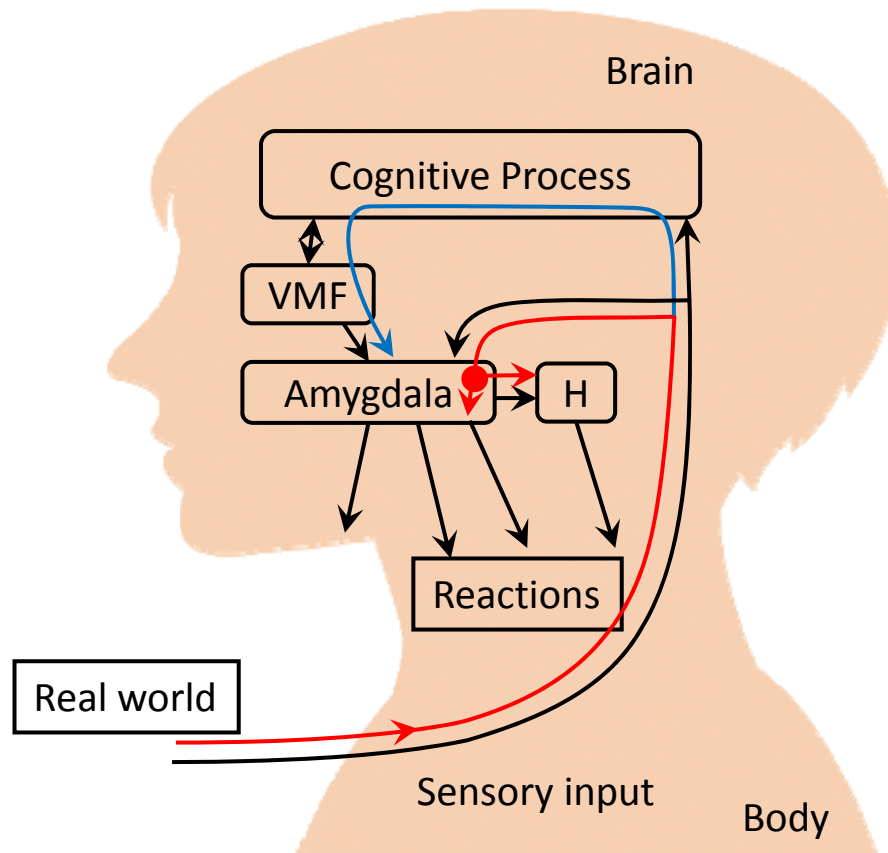
Agent: “Perhaps you are worried about Ruth?”

...

Emotion types used in the Affective Reasoner

Group	Specification	Name and emotion type
Well-being	appraisal of a situation as an <i>event</i>	joy: pleased about an <i>event</i> distress: displeased about an <i>event</i>
Fortunes-of-others	presumed value of situation as an <i>event</i> affecting another	happy-for: pleased about an <i>event</i> desirable for another gloating: pleased about an <i>event</i> undesirable for another resentment: displeased about an <i>event</i> desirable for another jealousy: resentment over a desirable mutually exclusive goal envy: resentment over a desired non-exclusive goal sorry-for: displeased about an <i>event</i> undesirable for another
Prospect-based	appraisal of a situation as a prospective <i>event</i>	hope: pleased about a prospective desirable <i>event</i> Fear: displeased about a prospective undesirable <i>event</i>
Confirmation	appraisal of a situation as confirming or disconfirming an expectation	satisfaction: pleased about a confirmed desirable <i>event</i> relief: pleased about a disconfirmed undesirable <i>event</i> fears-confirmed: displeased about a confirmed undesirable <i>event</i> disappointment: displeased about a disconfirmed desirable <i>event</i>
Attribution	appraisal of a situation as containing an attractive or unattractive <i>object</i>	pride: approving of one's own <i>act</i> admiration: approving of another's <i>act</i> shame: disapproving of one's own <i>act</i> reproach: disapproving of another's <i>act</i>
Attraction	appraisal of a situation as containing	liking: finding an <i>object</i> appealing disliking: finding an <i>object</i> unappealing
Well-being / attribution	compound emotions	gratitude: admiration + joy anger: reproach + distress gratification: pride + joy remorse: shame+distress
Attraction / attribution	compound emotion extensions	love: admiration + liking hate: reproach + disliking

Antonio Damasio's "Descartes' Error – Emotion, Reason and the Human Brain"



H: Hypothalamus,
VMF: ventromedial prefrontal cortex

If you come to know that animal or object or situation *X* causes fear, you will have two ways of behaving toward *X*. The first way is innate; you do not control it. Moreover, it is not specific to *X*; a large number of creatures, objects, and circumstances can cause the response. The second way is based on your own experience and is specific to *X*. Knowing about *X* allows you to think ahead and predict the probability of its being present in a given environment, so that you can avoid *X*, preemptively, rather than just have to react to its presence in an emergency. ...

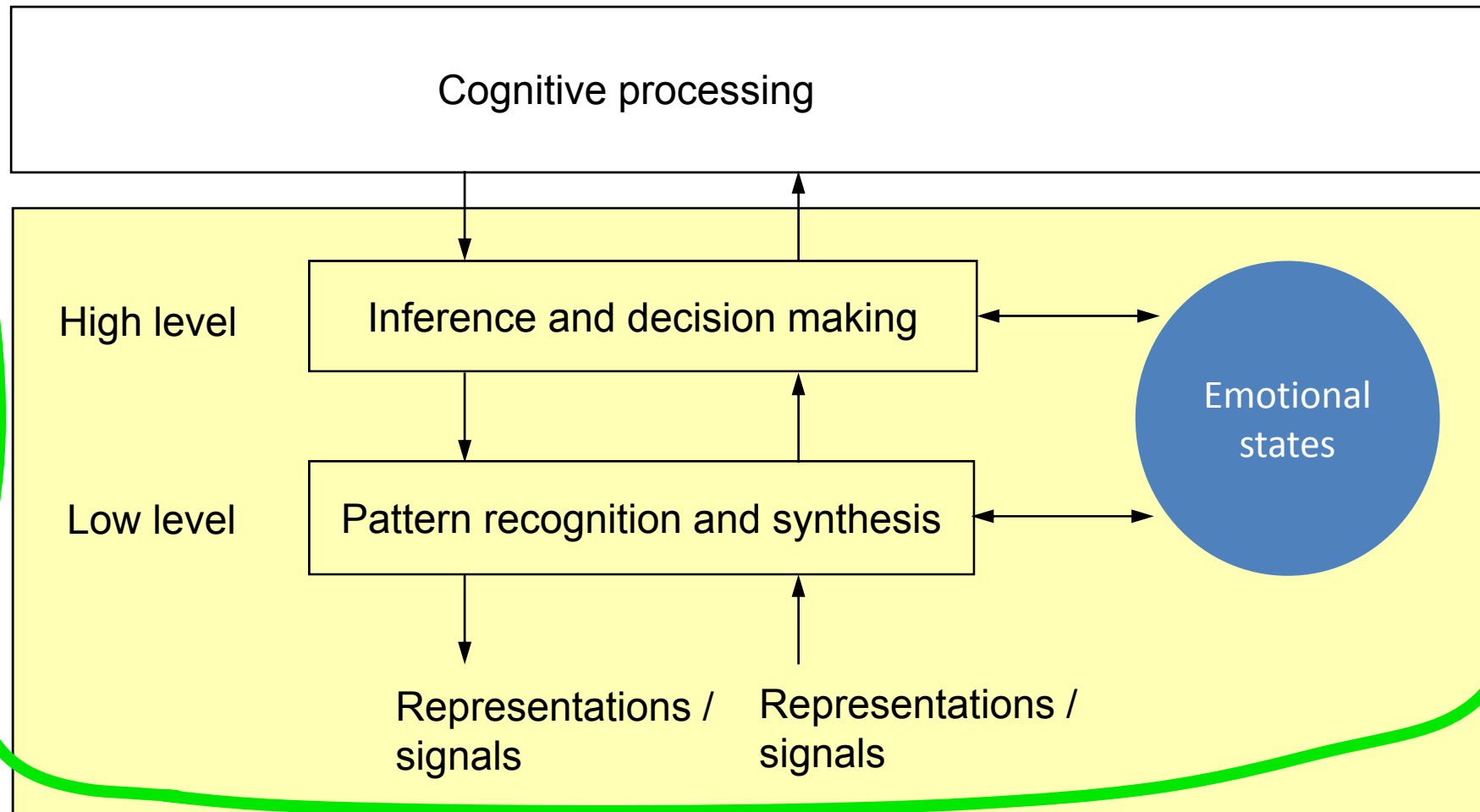
Primary emotions depend on limbic system circuitry, the amygdala and anterior cingulate being the primary players. After an appropriate stimulus activates the amygdala, a number of responses ensue: internal responses, muscular responses, visceral responses, and responses to neurotransmitter nuclei and hypothalamus.

Secondary emotions utilize the machinery of primary emotions. The stimulus may still be processed directly via the amygdala but is now also analyzed in the thought process, and may activate frontal cortices (VM). VM acts via the amygdala.

(p. 133-137)

[Damasio 1994]

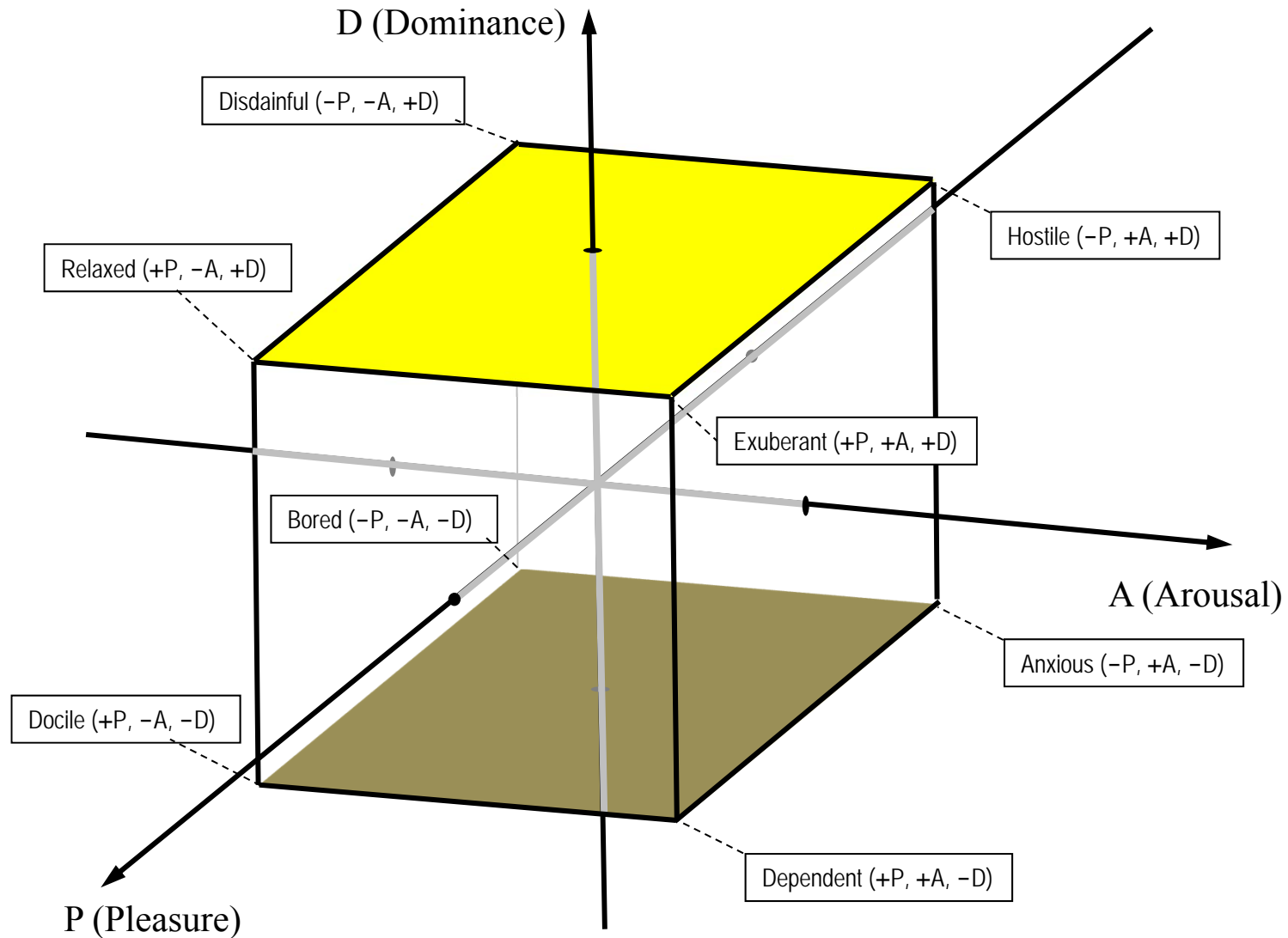
Affective Computing



Applications of affective computing

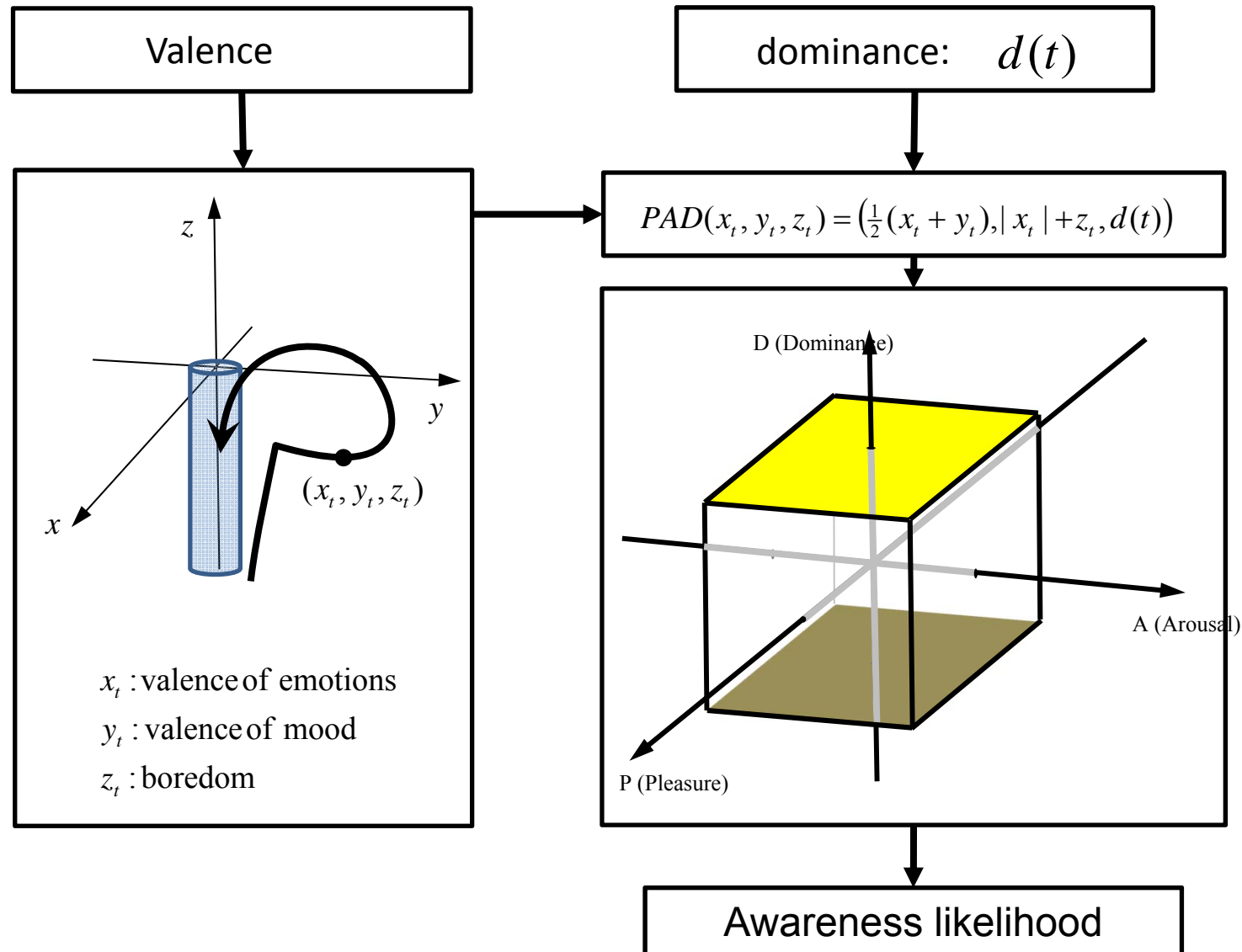
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PAD (Pleasure-Arousal-Dominance) model



[Mehrabian 1996]

Dynamical system model for primary and secondary emotion

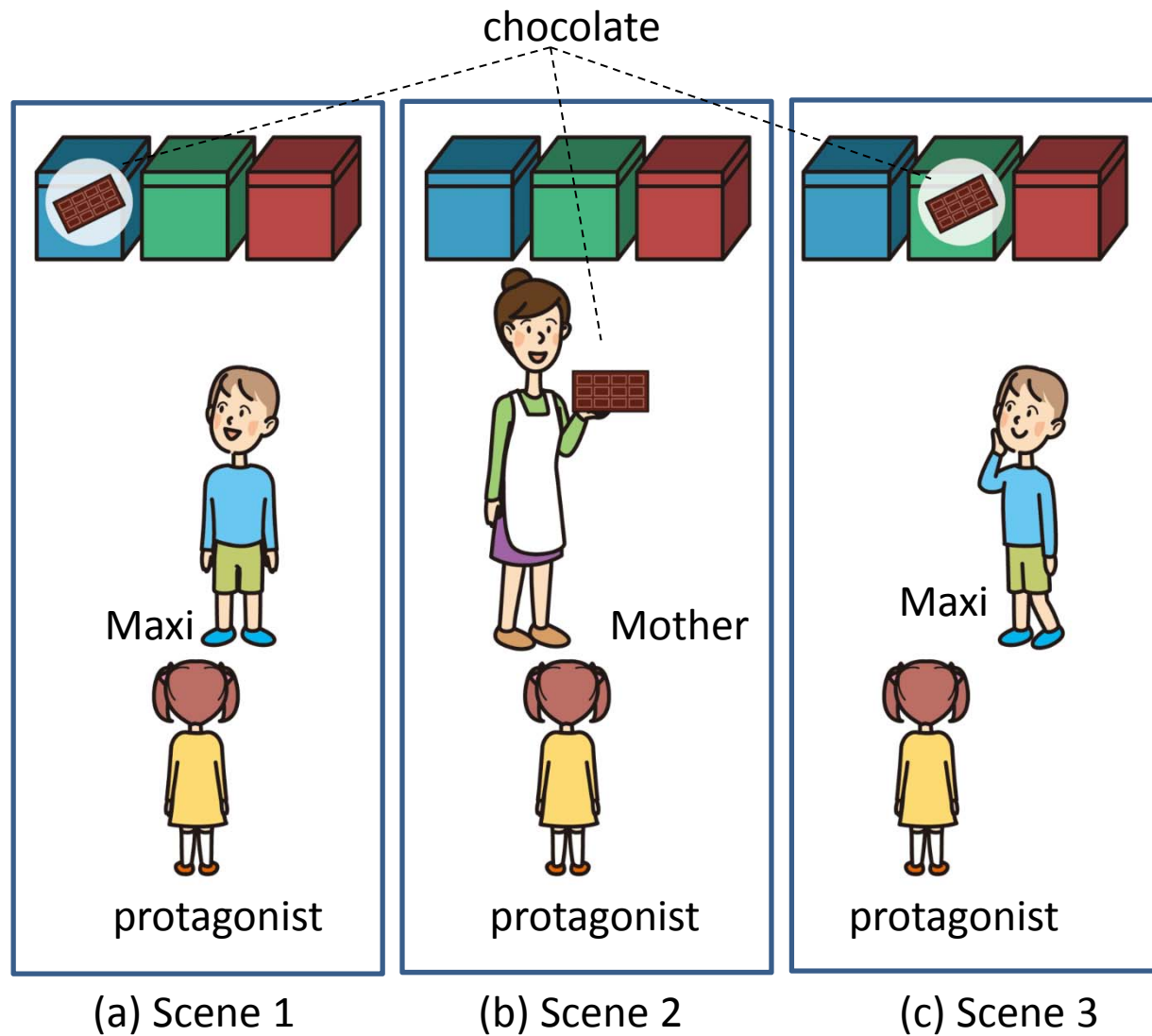


Theory of mind

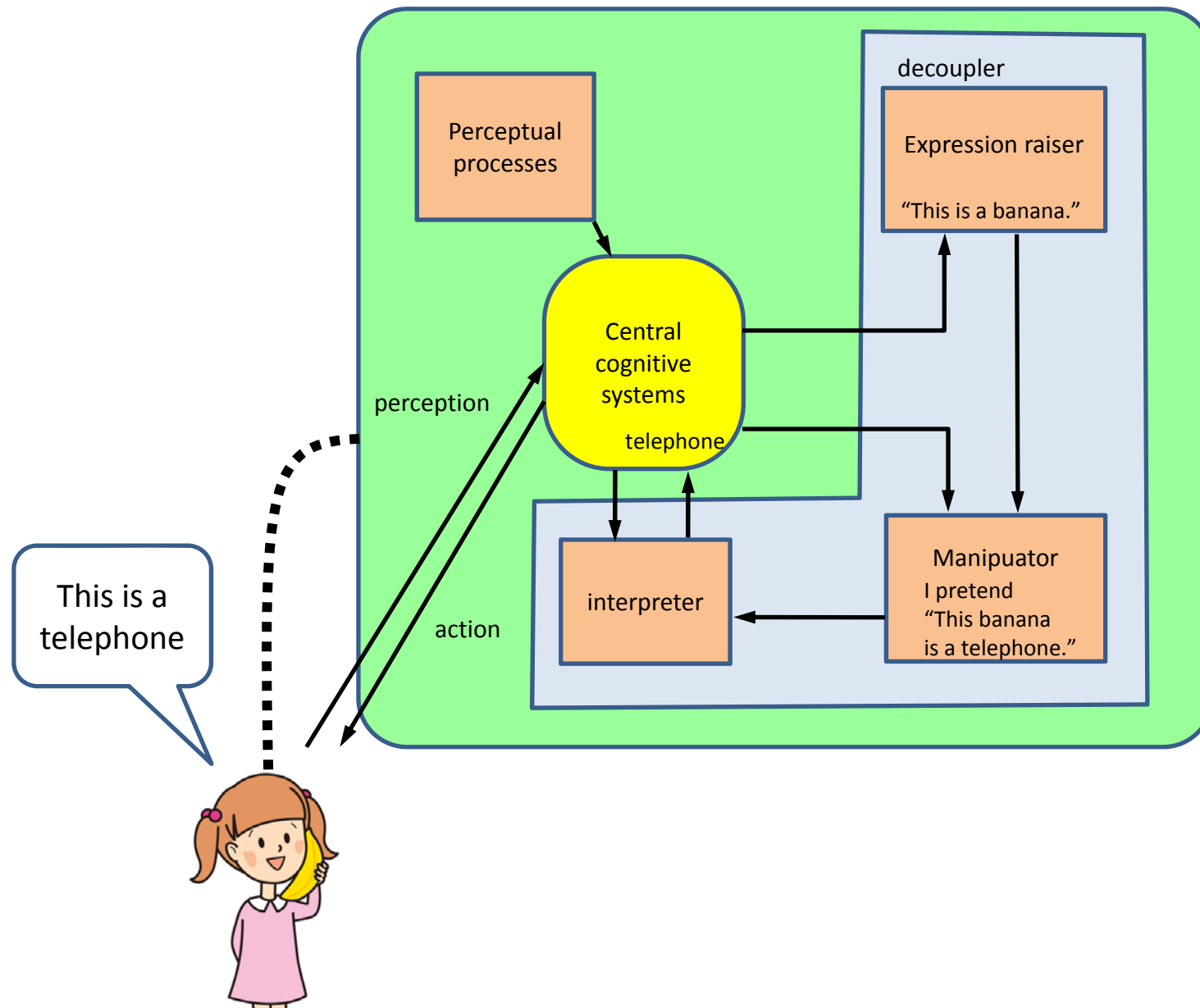
Understanding of another person's wrong belief requires explicit representation of the wrongness of this person's belief in relation to one's own knowledge. ... [Wimmer 1983]

[Theory of mind: an ability to] impute[] mental states to themselves and others. A system of inferences of this kind is properly viewed of as a theory because such states are not directly observable, and the system can be used to make predictions about the behavior of others. As to the mental states ... for example, purpose, or intention, as well as knowledge, belief, thinking, doubt, guessing, pretending, liking, and so forth. ... [Premack 1978]

Theory of mind

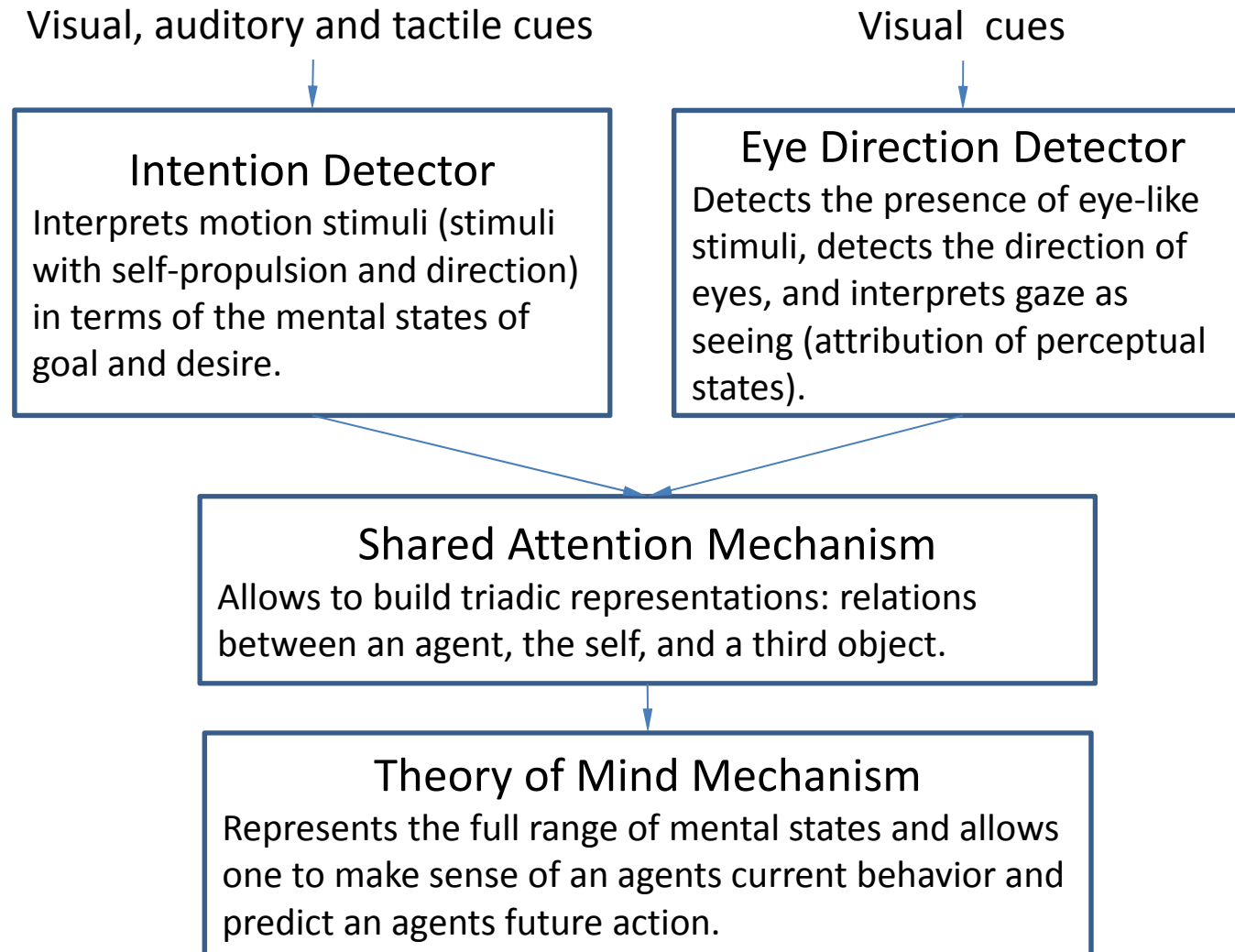


Theory of mind



Theory of mind

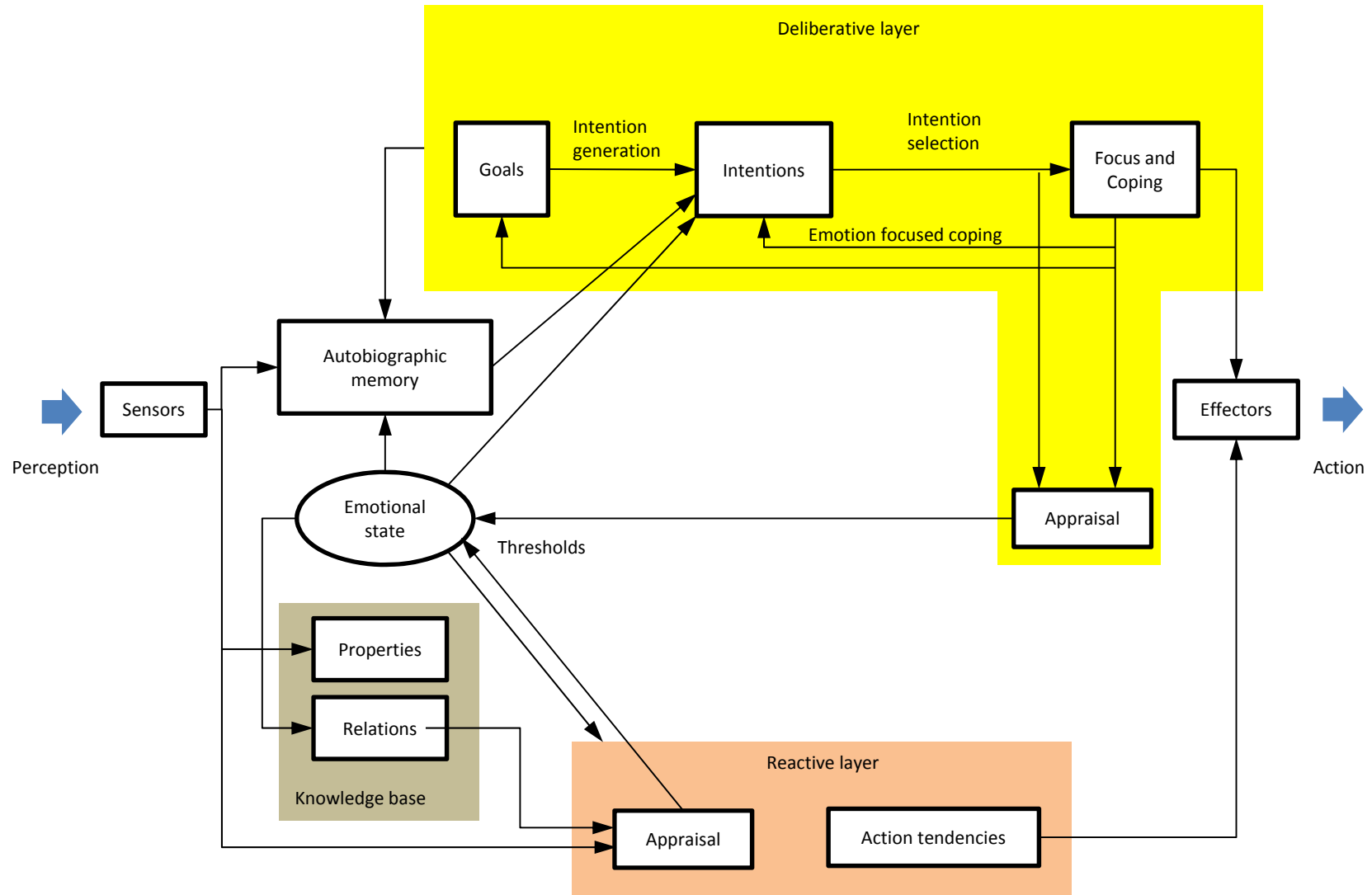
The computational architecture of theory of mind



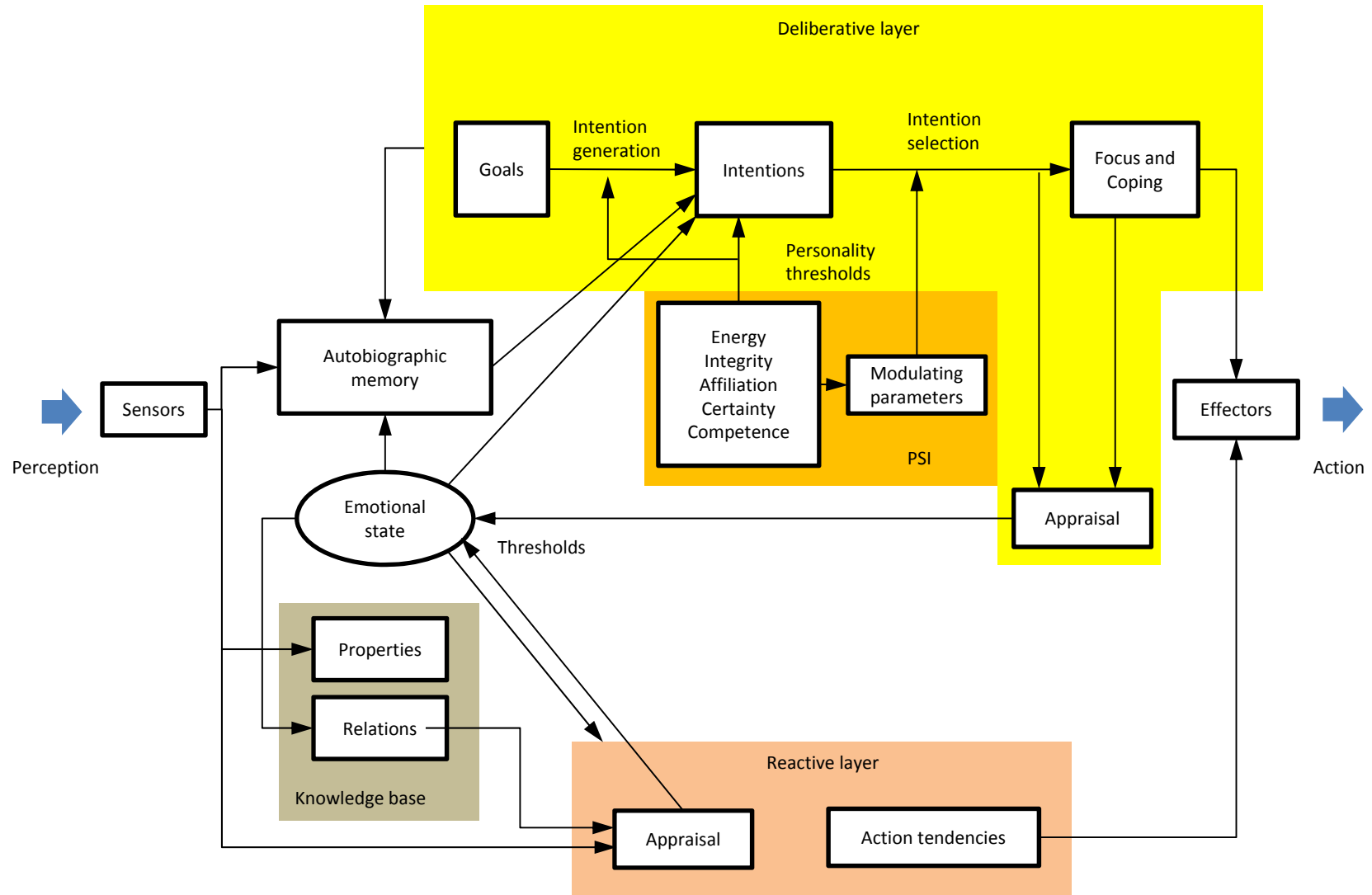
FearNot!



FAtiMA



FAtiMA-PSI



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