

Grounding emotion appraisal in autonomous humanoids

How this contributes to industry

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When we need robot autonomy ?

- When it is difficult for remote control
 - Extraterrestrial missions (e.g Mars rover)
- When they substitute humans
 - Cleaning robots (e.g iRobot)
 - Museum guides
 - etc.

The challenges for the autonomous robots

- Work in unstructured environments
- Work under time constraints
- Deal with limited resources like energy and computational power
- Saving energy behavior VS emergency behavior (more effort, speed, computational power etc.)

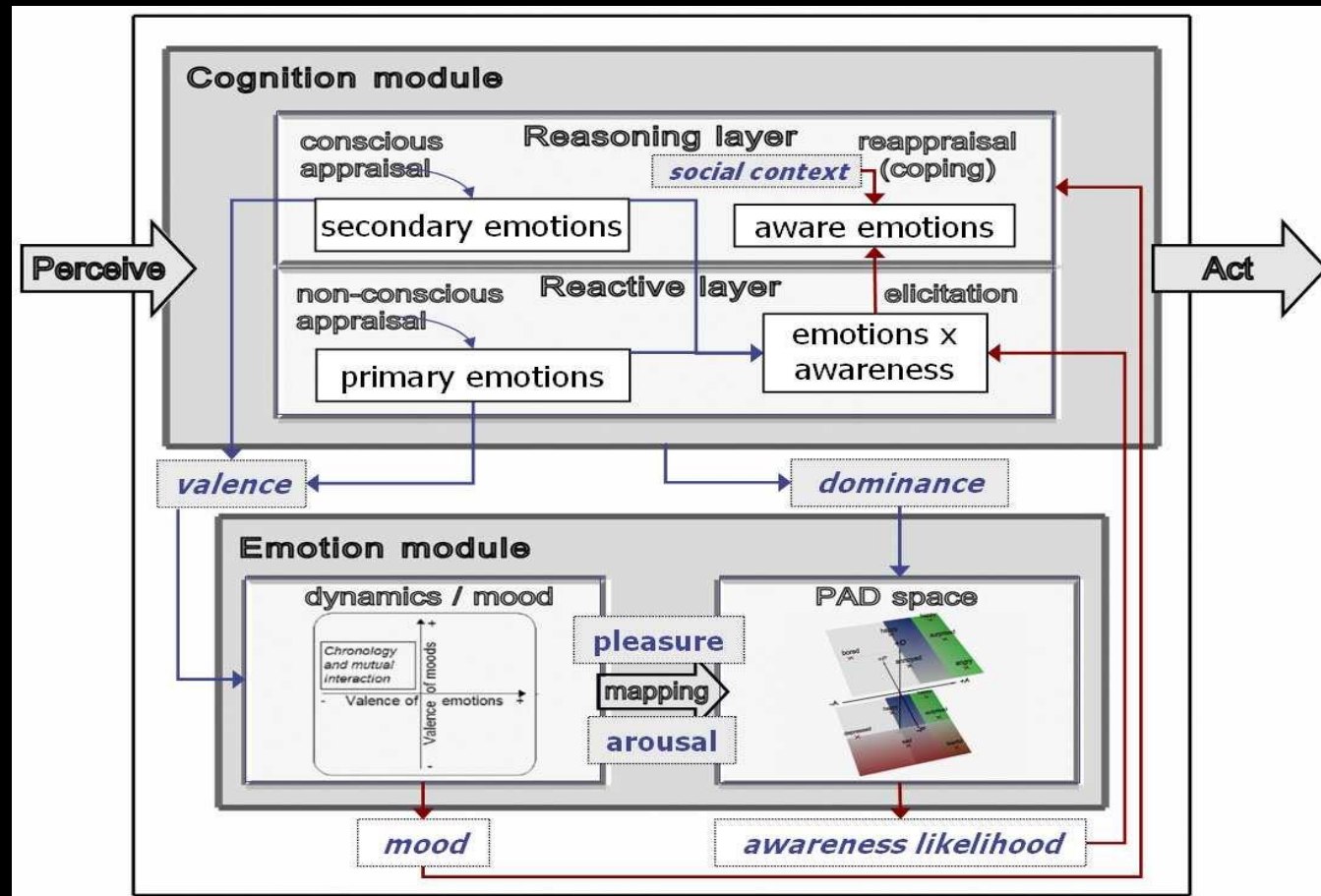
Emotions and autonomy

- Provide value system
- Plan management under limited resources
- Facilitation of cooperation

Cañamero, L. (2005). Emotion Understanding from the Perspective of Autonomous Robots Research. *Neural Networks*, 18: 445-455.

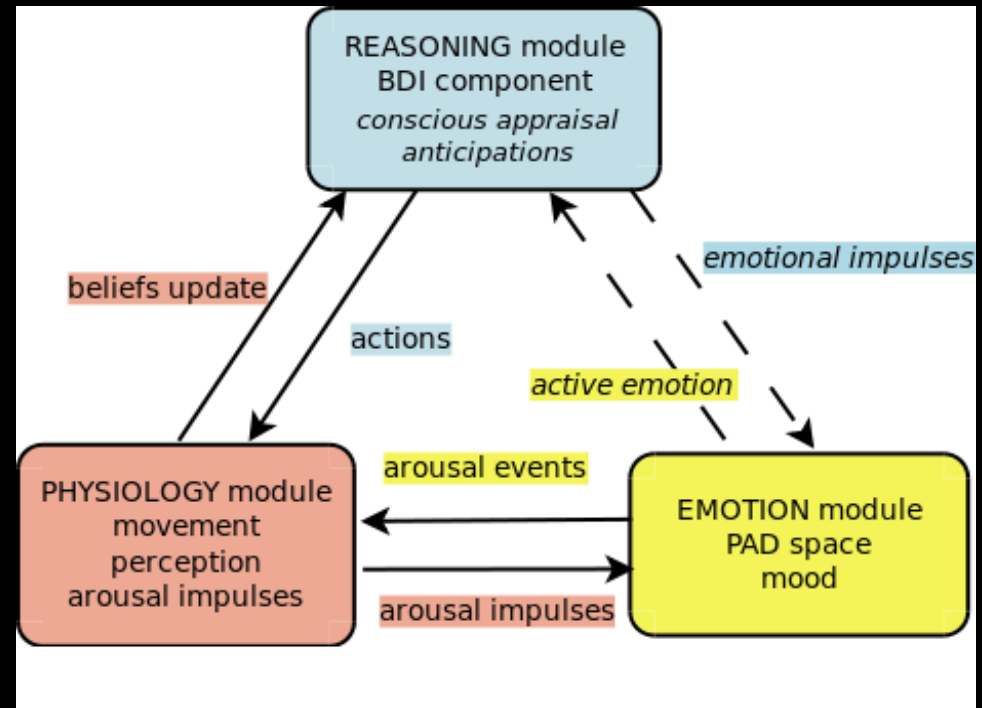
Oatley K., & Johnson-Laird, P.N. (1987). Towards a cognitive theory of emotions. *Cognition and Emotion*, 1, 29-50

Appraisal model of cognition and affect



Grounding of arousal into homeostatic processes

- Emotion as a perception of bodily changes
- Cue-deficit model of motivation
- The effect of arousal on effort of movement



Prinz, J.J. Gut Reactions: A Perceptual Theory of Emotion. Oxford University Press (2004)

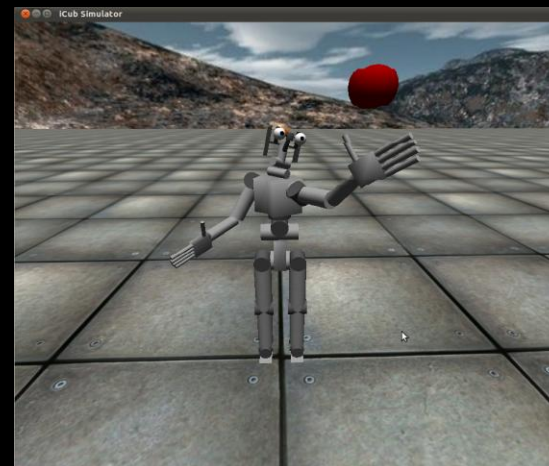
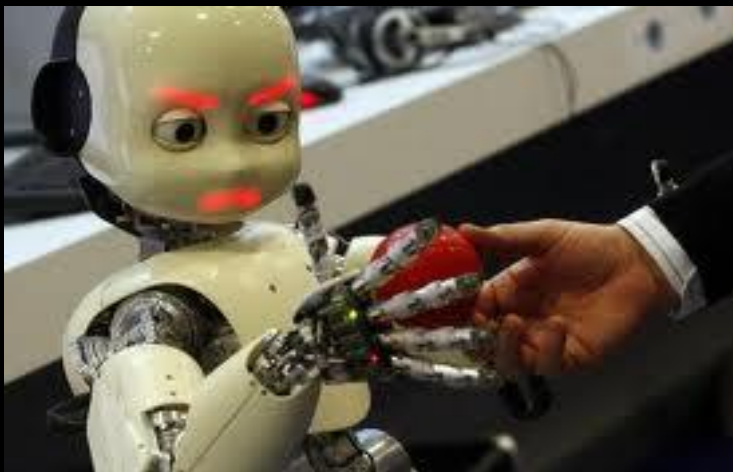
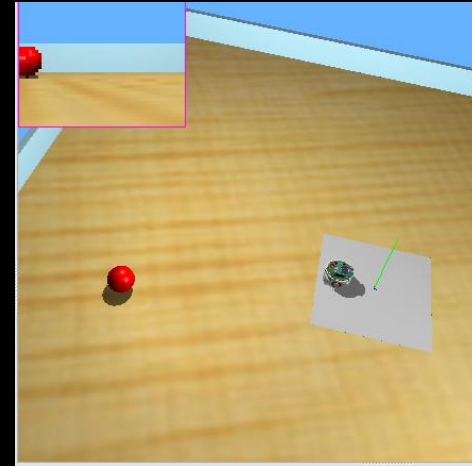
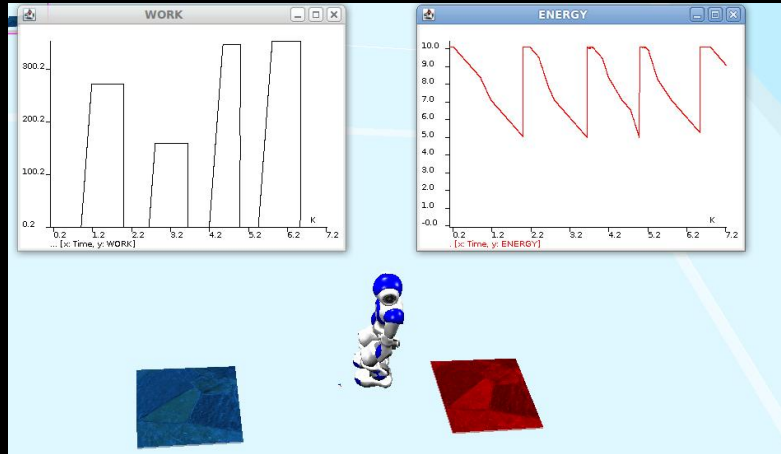
Bagherli, J., Vaez-Musavi & Pouneh Mokhtari, (2011) Effects of Arousal and Activation on Simple and Discriminative Reaction Time in a Stimulated Arousal State. World Applied Sciences Journal Volume 12 Number 10

McFarland, D., Spier, E. Basic Cycles, Utility and Opportunism in Self-Sufficient Robots Robotics and Autonomous Systems (1997)

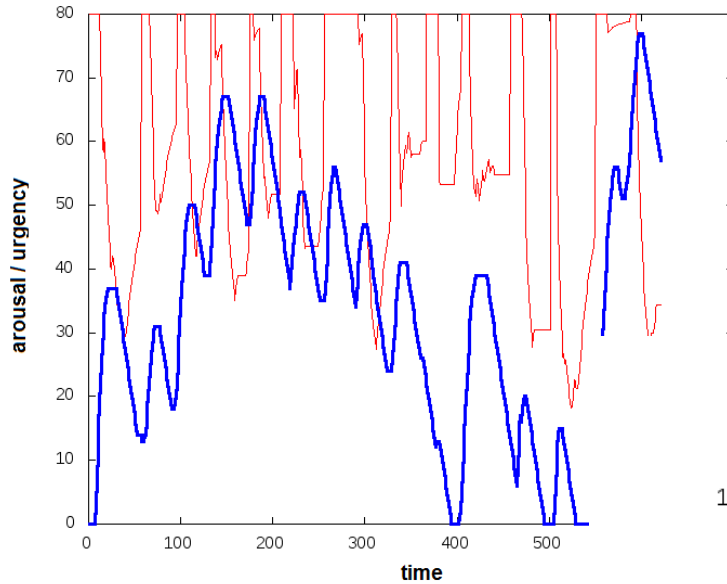
Basic cycles

- *If the robot is to be self- sufficient and economically viable then there are two basic resources that must be provided by the robot environment. ... energy ... and [work]”*
- *“Behavioural stability implies that the agent does not succumb to an irrecoverable debt in any vital resource.”*

Experimental scenarios

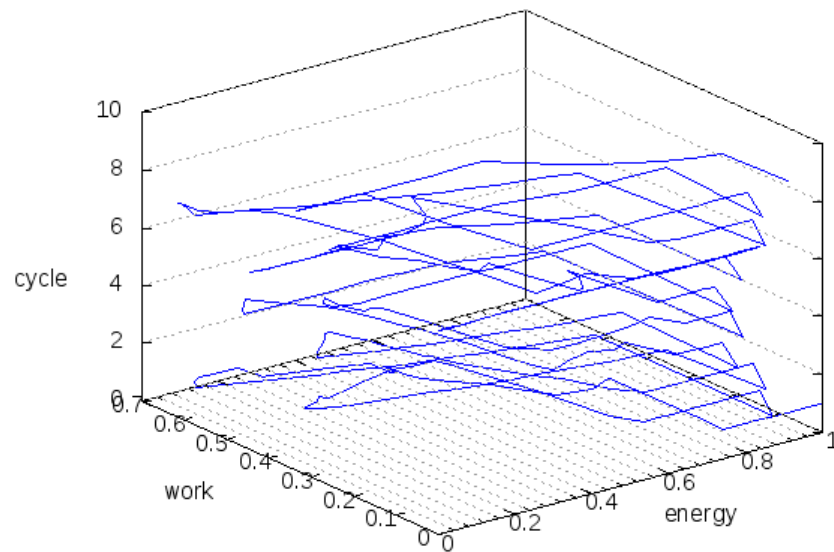


Experiment results



- Arousal and handling with urgency

- Sustainable basic cycles



Ongoing and future work

- Anticipate the energy consumption
 - A neural network learning the energy cost of an action
 - Secondary emotions based on the expectations of future events
- Emotional expressions and human-robot cooperation
 - Facial expression of robot's emotional state
 - Recognize and appraise human's emotional state

How this work contributes to industry?

- Exploiting the role of affective mechanisms to the biological organism's autonomy could help designing of more efficient architectures for autonomous robots
- Using expression and recognition of emotional state could facilitate cooperation with humans in service robotics
- Studying the relationship between effort and energy consumption could increase productivity of energy-autonomous robots

Thank you for your attention!



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