Connection Science
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713411269

Affective robotics - modelling emotion and motivation

Tom Ziemke[a]; Robert Lowe[a]; Anthony Morse[b]
[a] University of Skövde, Sweden [b] University of Plymouth, UK

Online publication date: 27 July 2010

To cite this Article Ziemke, Tom , Lowe, Robert and Morse, Anthony(2010) 'Affective robotics - modelling emotion and motivation', Connection Science, 22: 3, 193 — 195
To link to this Article: DOI: 10.1080/09540091.2010.489741
URL: http://dx.doi.org/10.1080/09540091.2010.489741

Connection Science
Vol. 22, No. 3, September 2010, 193–195

Affective robotics – modelling emotion and motivation

Introduction

The computational modelling of affective mechanisms – emotion and motivation in particular – has been an area of growing interest in adaptive behaviour, cognitive systems and robotics research in recent years (e.g. Ziemke 2008; Ziemke and Lowe 2009; Gros 2010). The study of the relation between affect and cognition has a long, but mixed history in science and philosophy (e.g. Pessoa 2008). As Damasio (1998) pointed out, while in the late nineteenth century emotion was considered to be of central importance to mind by influential thinkers such as Darwin, James and Freud, throughout most of the twentieth century it has commonly been viewed as the very antithesis of reason, and therefore largely ignored in the sciences of the mind. In the last 10–20 years, however, there has been a steadily growing interest in affect in the cognitive sciences, especially new research areas such as *affective neuroscience* (e.g. Panksepp 1998) and *affective computing* (Picard 1997), driven in particular by a wealth of neuroscientific insights into affective, motivational and emotional mechanisms and their role in cognition (e.g. Damasio 1994, 1999, 2003; LeDoux 1996; Panksepp 1998; Rolls 1999, 2005).

Insights into the neural and bodily underpinnings of affective mechanisms, as well as their fundamental role in natural cognition and adaptive behaviour in humans and other animals, have also resulted more recently in a growing body of scientific and technological work on computational models of emotion and motivation in different areas of artificial intelligence, cognitive systems and robotics research (e.g. Breazeal 2002; Trappl, Petta and Payr 2003; Hudlicka and Cañamero 2004; Cañamero 2005; Fellous and Arbib 2005). This special issue aims to contribute to this work by addressing in further detail the role that affective mechanisms play in natural cognition and behaviour, and might play in artificial cognitive systems/agents, in particular the emotional/motivational regulation of behaviour in autonomous robots.

The papers in this special issue

The papers included in this issue illustrate several different perspectives on the modelling of affective mechanisms, ranging from computational neuroscientific modelling of the neural substrates of emotional regulation (the amygdala, in particular) over the robotic modelling of human decision-making (in the *Iowa Gambling Task* (IGT)) to technological applications of affective mechanisms in robotics.

ISSN 0954-0091 print/ISSN 1360-0494 online

DOI: 10.1080/09540091.2010.489741
http://www.informaworld.com

The paper by Mirolli et al. provides a systems-level account of the role of the *amygdala* in the affective regulation of body, brain and behaviour. Through its interactions with multiple other brain systems, the amygdala is argued to have a fundamental role in the regulation of bodily states, the regulation of brain states via neuromodulators, the triggering of basic adaptive behaviours, and also in the regulation of high-level cognitive processes, such as the affective labelling of memories, the production of goal-directed behaviours, and the performance of planning/complex decision-making.

The paper by Burattini and Rossi provides a more technological perspective, dealing with periodic activations of behaviours and mechanisms of affective adaptation in behaviour-based robotics. Through a series of robotic experiments/case studies and their detailed analysis, the authors address in particular the modulatory role of motivation and emotion in designing adaptive robotic systems, providing mechanisms for context-dependent behavioural flexibility.

The paper by Lowe and Ziemke deals with the *somatic marker hypothesis* (e.g. Bechara and Damasio 2005), which posits that the role of emotions in (human) decision-making manifests through bodily responses to stimuli, and the IGT, the major source of empirical validation of that hypothesis. The paper proposes a computational/robotic modelling methodology based on a dynamical systems approach, and argues that this may be used to extend systematically the IGT benchmark to more naturalised, but nevertheless controlled, settings that might better explore the extent to which somatic states impact on complex decision-making.

Acknowledgements

This special issue follows the workshop on 'The Role of Emotion in Adaptive Behavior and Cognitive Robotics' held in Osaka in July 2008, in conjunction with the SAB conference, at which earlier versions of the contributions to this issue were presented, among others. We would like to thank all speakers and participants for interesting presentations and discussions. The workshop was supported by funding from euCognition – the European Network for the Advancement of Artificial Cognitive Systems (eucognition.org), and the editors have been supported by a European Commission grant to the FP6 project 'Integrating Cognition, Emotion and Autonomy' (ICEA, IST-027819, www.iceaproject.eu). Finally, we would like to thank all reviewers for their help in the preparation of the workshop and this issue.

References

Bechara, A., and Damasio, A.R. (2005), 'The Somatic Marker Hypothesis: A Neural Theory of Economic Decision', *Games and Economic Behavior*, 52, 336–372.

Breazeal, C. (2002), *Designing Sociable Robots*, Cambridge, MA: MIT Press.

Cañamero, L. (ed.) (2005), *Proceedings of the Symposium on Agents that Want and Like: Motivational and Emotional Roots of Cognition and Action*, Hatfield, UK: AISB.

Damasio, A.R. (1994), *Descartes' Error: Emotion, Reason, and the Human Brain*, New York: G.P. Putnam's Sons.

Damasio, A.R. (1998), 'Emotion in the Perspective of an Integrated Nervous System', *Brain Research Reviews*, 26, 83–86.

Damasio, A.R. (1999), *The Feeling of What Happens: Body, Emotion and the Making of Consciousness*, London: Vintage.

Damasio, A.R. (2003), *Looking for Spinoza: Joy, Sorrow and the Feeling Brain*, Orlando, FL: Harcourt.

Fellous, J.-M., and Arbib. M. (eds.) (2005), *Who Needs Emotions? The Brain Meets the Robot*, Oxford: Oxford University Press.

Gros, C. (2010), 'Cognition and Emotion: Perspectives of a Closing Gap', *Cognitive Computation* 2, 78–85.

Hudlicka, E., and Cañamero, L. (eds.) (2004), *Architectures for Modeling Emotion: Cross-disciplinary Foundations – Papers from the 2004 AAAI Symposium*, Menlo Park, CA: AAAI Press.

LeDoux, J.E. (1996), *The Emotional Brain*, New York: Simon & Schuster.

Panksepp, J. (1998), *Affective Neuroscience: The Foundations of Human and Animal Emotions*, Oxford University Press: New York.

Pessoa, L. (2008), 'On the Relationship between Emotion and Cognition', *Nature Reviews Neuroscience*, 9, 148–158.

Picard, R. (1997), *Affective Computing*, Cambridge, MA: MIT Press.

Rolls, E. (1999), *The Brain and Emotion*, Oxford: Oxford University Press.

Rolls, E. (2005), *Emotion Explained*, Oxford: Oxford University Press.

Trappl, R., Petta, P., and Payr, S.(eds.) (2003), *Emotions in Humans and Artifacts*, Cambridge, MA: MIT Press.

Ziemke, T. (2008), 'On the Role of Emotion in Biological and Robotic Autonomy', *BioSystems*, 91, 401–408.

Ziemke, T., and Lowe, R. (2009), 'On the Role of Emotion in Embodied Cognitive Architectures: From Organisms to Robots', *Cognitive Computation*, 1, 104–117.

Tom Ziemke
University of Skövde, Sweden

Robert Lowe
University of Skövde, Sweden

Anthony Morse
University of Plymouth, UK