ECRONICON OPEN ACCESS

EC PSYCHOLOGY AND PSYCHIATRY

Mini Review

Cognitive Architectures for Emotional Agents

Mauricio Iza*

Department of Basic Psychology, University of Malaga, Spain

***Corresponding Author**: Mauricio Iza, Department of Basic Psychology, University of Malaga, Spain

Received: December 17, 2018; **Published:** February 28, 2019

Abstract

Findings on the role that emotion plays in human behavior have transformed Artificial Intelligence computations. Modern research explores how to simulate more intelligent and flexible systems. However, none of these models fully address the integration of emotion generation and its effects in the context of cognitive processes. This work tries to unify several models of computational emotions with work done in cognitive architectures.

Keywords: *Cognitive Architectures; Emotion; Affective Computing*

Cognitive architecture approach

The cognitive architecture approach has a long history with different implementations for solving a huge variety of tasks. However, all these architectures maintain some key concepts and principles that reflect the philosophical presuppositions with the classical AI [1-6]. Here, we will discuss these conceptual principles and explain some examples of cognitive architectures.

These architectures have a number of limitations [7,8]. While classical AI approach has evolved together with the serial-fast processor nature of available computing technology, the cognitive architecture approach claims for massively parallel data structures and processes. Implementing these structures and processes finishes in reduced performance along some dimensions. In this respect, we need a convergence among cognitive architectures from two points of view: (i) computational aspect, necessity to perform complex tasks in demanding contexts; (ii) implementational aspect, reflecting the exponentially increasing knowledge figure about the nature of brain processes.

A psychologically plausible cognitive architecture has to include all mechanism and processes: memory modules, inference mechanisms and learning algorithms. Even more, it should integrate how emotion is involved in these cognitive processes: how emotion has to be integrated within a cognitive architecture.

The goal would be a significant implementation of cognitive architectures that takes the broad range of cognition and emotion, from perception to motor action to reasoning and problem solving [9]. Most implementations are hard-wired in respect to the relation between emotion and cognition [10]. Architectures need a more serious integration in order to be used in robotics and emotion-sensitive human-computer interaction.

Affective computing

Affective computing [11] consists of recognition, expression, modeling, communicating and responding to emotions. The goal of this domain is to develop computer-based systems that recognize and express emotions like humans. The system must be able to sense and response appropriately to user's emotional states.

On the one hand, appraisal theories have dominant in computational models of emotions and have been applied extensively in symbolic architectures, because their theoretical structures can easily be translated into if-then rules [12-14].

On the other hand, dimensional architectures use to reject symbolic representations or emotional labels. The implementation of emotional intelligence relies on cognitive features present in the architecture. Normally it does not implement other phenomena, like explicit learning or theory of mind (recognition and understanding of other's emotions).

Finally, new emotional hybrid architectures try to combine both the situated conceptualization approach and the dynamical mode of functioning approach [15]. For instance, in the tripartite approach of Larue., *et al.* [16] three main dimensions are important to understand emotions: semantic, cognitive and neurophysiological. In the proposed architecture, each dimension emerges from the interaction and mechanisms taken from the two approaches.

Larue, Poirier and Nkambou [16] present an architecture where three sets of processes can interact: processes responsible for fast context-sensitive behaviors (an autonomous mind), processes responsible for cognitive control (an algorithmic mind) and processes responsible for deliberative processing and rational behavior (a reflective mind). By reasoning on counterfactual situations, the system tries to link emotional semantic and cognition with neuromodulations. These ones, proposed as physiological components, act like an attentional focus on salient emotional aspects of environments.

A possible way for evaluating the provided advancements of the different architectures, or the encountered problems that prevent to obtain psychological and biologically plausible advancements [17,18], is that one of focusing on classes of problems that are easily manageable for humans but very hard to solve for machines. For example, these involve aspects concerning commonsense reasoning about space, action, change and language categorization [6]; selective attention; integration of multi-modal perception; the interaction between cognition and emotion [19,20]; learning from few examples [21]; robust integration of mechanisms involving planning, acting, monitoring and goal reasoning [9,22].

Future Research

Future research has to take seriously into account this question: how to develop models where emotion interacts with cognitive processing. In this context, a psychological framework of emotional language processing is needed to describe the steps humans take when they interact with other computer systems or agents. This framework can be used to help evaluate the efficiency and naturalness of a user interface (e.g. design principles, emotional inferences, etc.). So, the key question is to represent, reason, and exploit various models of word processing to more effectively process input, generate output, and manage the dialog and interaction between different agents. The input data (words) should be, cognitive and emotionally, processed in a joint feature space according to a context-dependent model.

Conclusion

In conclusion, we have discussed that emotion has to be computationally integrated within a psychologically plausible cognitive architecture. That is, emotion should be integrated on mechanisms and processes of attention, learning, decision making, action and reasoning.

Bibliography

1. Anderson M. "Embodied cognition: A field guide". *Artificial Intelligence* 149.1 (2003): 91-130.
2. Anderson JR and Lebiere C. "The Newell test for a theory of cognition". *Behavioral and Brain Science* 26.5 (2003): 587-637.
3. Arbib MA and Fellous JM. "Emotions; From brain to robot". *Trends in Cognitive Science* 8.12 (2004): 554-561.

4. Boden M. "AI. Its nature and future". Oxford University Press (2016).
5. Laird J. "The Soar cognitive architecture". MIT Press (2012).
6. Sun R. "Anatomy of the Mind: Exploring Psychological Mechanisms and Processes with the Clarion Cognitive Architecture". Oxford University Press (2016).
7. Kurup U and Lebiere C. "What can cognitive architectures do for robotics?" *Biologically Inspired Cognitive Architectures* 2 (2012): 88-99.
8. Langley P., *et al*. "Cognitive architectures: Research issues and challenges". *Cognitive Systems Research* 10.2 (2009): 141-160.
9. Clark A. "Surfing uncertainty". Oxford University Press (2016).
10. Ezquerro J and Iza M. "Language Processing, Computational Representational Theory of Mind and Embodiment: Inferences on verbs". In G. Dodig-Crnkovic and R. Giovagnoli (eds.): Representation and reality in humans, other lining organisms and intelligent machines. Springer (2017).
11. Picard RW. "Affective computing". Cambridge, MA: The MIT Press (1997).
12. Marsella S and Gratch J. "EMA: A process model of appraisal dynamics". *Journal of Cognitive Systems Research* 10.1 (2009): 70-90.
13. Mohammad S and Turney P. "Crowdsourcing a word-emotion association lexicon". *Computational Intelligence* (2012): 1467-8640.
14. Watanabe T. "Human-entrained embodied interaction and communication technology". In S Fukuda (ed.): Emotional engineering. London: Springer Verlag (2011): 161-178.
15. Sun R., *et al*. "Emotion: a unified mechanistic interpretation from a cognitive architecture". *Cognitive Computation* 8.1 (2016): 1-14.
16. Larue O., *et al*. "The emergence of (artificial) emotions from cognitive and neurological processes". *Biologically Inspired Cognitive Architectures* 4 (2013): 54-68.
17. Kushiro K., *et al*. "Robot uses emotions to detect and learn the unknown". *Biologically Inspired Cognitive Architectures* 4 (2013): 69-78.
18. Lieto A., *et al*. "The role of cognitive architectures in general artificial intelligence". *Cognitive Systems Research* 48 (2018): 1-3.
19. Zhanj L and Barnden J. "Affect sensing using linguistic, semantic and cognitive cues in multi-threaded improvisational dialogue". *Cognitive Computation* 4.4 (2012): 436-459.
20. Juvina I., *et al*. "Modeling valuation and core affect in a cognitive architecture: The impact of valence and arousal on memory and decision-making". *Cognitive Systems Research* 48 (2018): 4-24.
21. Pittermann J., *et al*. "Handling emotions in human-computer dialogues". Berlin: Springer Verlag (2010).
22. Choi D and Langley P. "Evolution of the ICARUS architecture". *Cognitive Systems Research* 48 (2018): 25-38.

Volume 8 Issue 3 March 2019