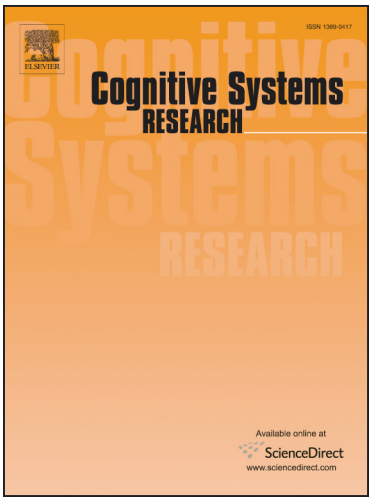

Modeling valuation and core affect in a cognitive architecture: The impact of valence and arousal on memory and decision-making

Ion Juvina, Othalia Larue, Alexander Hough

PII: S1389-0417(16)30217-0
DOI: http://dx.doi.org/10.1016/j.cogsys.2017.06.002
Reference: COGSYS 568

To appear in: *Cognitive Systems Research*

Received Date: 16 November 2016
Revised Date: 27 May 2017
Accepted Date: 4 June 2017

Please cite this article as: Juvina, I., Larue, O., Hough, A., Modeling valuation and core affect in a cognitive architecture: The impact of valence and arousal on memory and decision-making, *Cognitive Systems Research* (2017), doi: http://dx.doi.org/10.1016/j.cogsys.2017.06.002

Manuscript accepted for publication in Cognitive Systems Research 2017

Modeling valuation and core affect in a cognitive architecture: The impact of valence and arousal on memory and decision-making

Ion Juvina (ion.juvina@wright.edu)*, Othalia Larue (othalia.larue@wright.edu), & Alexander Hough (hough.15@wright.edu)

[1]Department of Psychology, Wright State University
3640 Colonel Glenn Hwy., Dayton, OH 45435 USA

Abstract

A novel approach to adding primitive evaluative capabilities to a cognitive architecture is proposed. Two sub-symbolic quantities called valuation and arousal are learned for each declarative memory element based on usage statistics and the reward it generates. As a result, each memory element can be characterized as positive or negative and having a certain degree of affective intensity. In turn, these characteristics affect the latency and probability of retrieval for that memory element. Two global accumulators called core-affect-valuation and core-affect-arousal are computed as weighted sums of all retrievable valuations and arousals, respectively. The weights reflect usage history, context relevance, and reward accrual for all retrievable memory elements. These accumulators describe the general disposition or mood of the system. Core affect dynamics are used as reward signals to learn valuation and arousal values for new objects or events. The new architectural mechanism is used to develop two models that demonstrate the impact of affective valence and arousal on memory and decision-making. The models are fit to datasets from the literature and make novel predictions. The value of including valuation and core affect mechanisms in a cognitive architecture is discussed.

Highlights

- Novel approach to modeling valuation and core affect in a cognitive architecture
- Computational cognitive models demonstrate how new affective mechanism operates within an integrated cognitive architecture
- The models account for both costs and benefits of negative affect

Keywords

Cognitive architecture; Computational cognitive modeling; Valuation; Core affect; Memory; Decision-Making.

1 Introduction and background

Traditionally, unified theories of cognition and cognitive architectures have ignored affect and emotion. More recently, we have seen attempts to integrate affect and emotion within classical cognitive architectures (Dancy, 2013; Marinier, Laird, & Lewis, 2009; Marsella & Gratch, 2009; Sun, Wilson, & Lynch, 2016) or to design new architectures dedicated to modeling affective phenomena (e.g., Becker-Asano & Wachsmuth, 2008).

* Corresponding author