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A Cybernetical Perspective on Emotion-Cognition Interactions as Self-Directed Adaptation in Situated Decision-Makers

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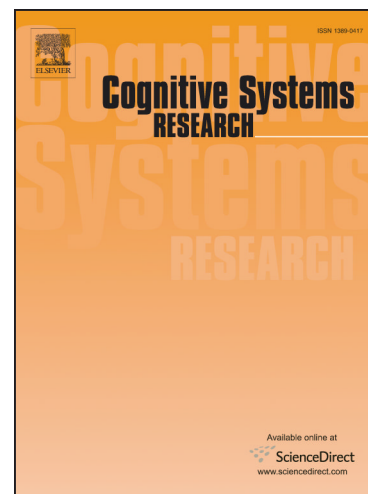
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## A Cybernetical Perspective on Emotion-Cognition Interactions as Self-Directed Adaptation in Situated Decision-Makers

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### Abstract

Emotion-cognition interactions are often (Simon (1967); Sloman (2002)) understood as adaptational mechanisms that help to cope bounded decision-makers with constraints and dangers forced upon by their environments. In this work, emotions are regarded as emergent properties of interconnected systems of functional routines - decision-making, memory access, etc. - and associated internal monitoring and modulation systems. Couplings between these mechanisms create internal bidirectional feedback loops that can sustain globally synchronized responses, which have been referred to as "appraisal-emotion"-amalgams (Lewis (2005)). Although emotions have been suggested as crucial components for enabling biological agents to cope with difficulties of decision-making in complex, partially unknown environments (Hanoch (2002); Muramatsu & Hanoch (2005); Sloman (2011)), research on artificial emotion models lacks common frameworks to explore design spaces for particular classes of emotionally-influenced systems (Hudlicka (2008); Sloman (2002)), rendering it difficult to identify basic principles or architectural constraints (Sloman (1999, 2002); Hudlicka (2008)). This article presents a systems-level framework for modeling emotion-cognition interaction in domain-independent decision-making systems based on Optimal Control Theory as a particular form of self-modulation driven by continual evaluation of the relationship between system and environment.

### 1. Introduction

More than thirty years ago, Sloman & Croucher (1981) stated that "the need to cope with a changing and partly unpredictable world makes it very likely that any intelligent system with multiple motives and limited powers will have emotions". Today, the vast majority of works in the field of "Affective Computing" deal with either detection and classification, or emulation of, *human* emotions to serve various useful purposes in human-machine interaction, see Picard & Picard (1997). Instead, the statement quoted above is meant to describe systems that genuinely *have* emotions (not necessarily implying that they are aware of this fact), which do influence the control system of an agent in many different ways and on different levels. Crucially, they do not state that intelligent systems in complex environments and multi-criteria tasks should be designed to have emotions, but rather that they eventually would have them - whether the designer had intended to implement emotions or not.

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