Chapter 9
The Embodiment of Synthetic Emotion

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ABSTRACT
Emotions are fundamentally embodied phenomena - but what exactly does this mean? And how is embodiment relevant for synthetic emotion? The specific role of embodied processes in the organisation of cognition and behaviour in biological systems is too complex to analyse without abstracting away the vast majority of variables. Robotic approaches have thus ignored physiological processes. At most, they hypothesise that homeostatic processes play a role in the cognitive economy of the agent – “gut feeling” is the embodied phenomenon to be modelled. Physiological processes play an actual role in the control of behaviour and interaction dynamics beyond information-processing. In this chapter, the authors introduce a novel approach to emotion synthesis based on the notion of morphofunctionality: the capacity to modulate the function of subsystems, changing the overall functionality of the system. Morphofunctionality provides robots with the capacity to control action readiness, and this in turn is a fundamental phenomenon for the emergence of emotion.

INTRODUCTION: EMBODIMENT AND EMOTION

In recent times the notion of embodiment has gained a central place in the cognitive science literature, to the extent that a new paradigm is said to have emerged from it (Clark 1999). There are many senses in which the concept of embodiment is used, from a metaphysical view that denounces dualism (Lakoff & Johnson 1999), a scientific approach that defends dynamical system models (Port & Van Gelder 1995), to a technological...
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stance that advocates for robots as the sit of artificial intelligence (Brooks 1999). There is not a straightforward interpretation of the phenomenon of embodiment, and its relevance for artificial cognitive agents remains an open area of research.

“The embodied view holds that the particular forms and patterns of physical activity in cognitive systems (e.g., human organisms) shape central aspects of those systems’ cognitive profiles” (Gibbs 2006). This view is often contrasted to cognitivism, the idea that we can develop models of the workings of the mind by abstracting away everything except some representation of mental content.

But in one area of psychology this was not the case, even in the height of cognitivism – emotion theory. We can speak of cognitive structure of emotion (Ortony 1990), but this is not enough to explain emotion as adaptive phenomena. It is not only that embodied processes are required for the explanation of cognitive processes associated to emotion – those embodied processes require explanation themselves. Since Aristotle defended that without a body there is no emotion, this thesis has hardly been contested, and trying to tear apart the body from the mind in emotion theory has proven pretty hard. Even Descartes, the father of our dualism, failed when trying to portray emotions as events of the mind. The link to the body was so strong that his theory could well be called an embodied theory of emotion.

Emotion theorists had therefore to deal with the issue of embodiment, and the relationship between cognition, emotion and physiological states has been the central issue in emotion theory for over a century, from James to Damasio. Even appraisal theories, often blamed for highlighting the cognitive content of emotion, integrated embodiment in their theories much before the new paradigm emerged. Embodiment is thus so central to emotion that an embodied theory is the only kind of theory that can exist.

The synthetic approach to emotion must therefore address the issue of embodiment. Nevertheless, most synthetic approaches, even in robotics, have neglected embodiment and preferred a cognitive architecture approach: understanding the role of emotional mechanisms in the cognitive economy of the agent, in order to allow the system to cope with uncertainties and limitation of resources (Sloman 1987). Robotics and synthetic embodiment nevertheless opens new avenues to understand the embodiment of emotion.

In this chapter we present the morphofunctional approach: a framework to understand emotions from the control of changes to functional aspects of the body. This concept, we argue, can be applied to biological systems, and exploited in synthetic systems to attune the disposition of the agent to the situation. This approach, described in the following sections, aims to serve as a framework for future embodied models of emotion.

The Challenge of Embodiment in Emotion

When we say that emotions are embodied, we are not talking about the impossibility to experience emotion without a body. We are saying that bodily events are not mere symptoms of what happens in emotion, they are the very reason of emotion, they are emotions. It is not just that we must take into account bodily processes: the organisation of such bodily processes, the adaptation they provide, is what needs to be explained in the first instance.

An embodied theory of emotion must go beyond the fact that the body is fundamental for emotion, and explain how the organisation of bodily processes facilitates adaptation. This is not a straightforward task. First, it is not clear what embodied processes (as found in biological agents) should we start with: those found in the brain and within it specialised areas? The peripheral nervous system? The endocrine system? Or even