

# The Embodied Brain: An Argument from Neuroscience for Radical Embodied Cognition

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**Abstract.** In this programmatic paper we develop an account of embodied cognition based on the inseparability of cognitive and emotional processing in the brain. We argue that emotions are best understood in terms of action readiness [1, 2] in the context of the organism's ongoing skillful engagement with the environment [3, 4, 5]. States of action readiness involve the whole living body of the organism, and are triggered by possibilities for action in the environment that matter to the organism. Since emotion and cognition are inseparable processes in the brain it follows that what is true of emotion is also true of cognition. Cognitive processes are likewise processes taking place in the whole living body of an organism as it engages with relevant possibilities for action.

## 1 Introduction

Our aim in this paper will be programmatic. We propose a definition of embodied cognition based on the inseparability of emotional and cognitive processes in the brain [6]. Our argument has the following three steps:

- (1) Cognition is embodied because cognition and emotion are inseparable processes in the brain.
- (2) Emotion is a dynamic process involving the organism's whole body.
- (3) From the inseparability of emotion and cognition in the brain it follows that cognition is likewise a dynamic process involving the organism's whole body.

We align ourselves with proponents of radical embodied cognition in endorsing the non-decomposability of the brain-body-environment system. We take this thesis to be implied by the functional integration of emotional and cognitive processing in the brain. We show how recent research concerned with large-scale patterns of connectivity in the brain challenges a decompositional analysis of the brain into regions and components that carry out either emotional or cognitive psychological functions. The current evidence points instead to a theory of brain processes as complex, non-linear, self-organizing processes composed of "intricately interconnected, interacting elements" [7]. We find interconnection, interaction and mutual influence among components (or neural regions) resulting, we argue in processes that are simultaneously both cognitive and emotional.

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How can we make an argument from the non-decomposability of cognitive and emotional processes within the brain to the non-decomposability of the larger brain-body-environment system? We begin by providing a tweak to psychological constructionist theories of emotion which interpret the integration of cognitive and emotional neural processes in terms of interactions between domain general neural networks [8]. We suggest (following arguments developed by Luiz Pessoa [9]) that structure-function mappings are not fixed and static properties of networks. Instead structure-function relationships are dynamic, with the functions a given network performs varying over time in a context-dependent manner. It is the latter finding which we take to support the non-decomposability of the brain-body-environment system. To determine the precise functional contribution a network is making to behavior requires zooming out, and having in view the whole organism in its interaction with the environment. Emotional-cognitive processes don't only take place inside of brains, but are processes that involve constant interaction between the brain and the whole living body of the organism in an ecological setting.

The first two steps in our argument establish the inseparability of emotion and cognition in the brain and the deep dependence of emotional processes on the whole body of the living organism in its practical skilled engagement with the environment. We take these two steps to imply a third step: the conclusion that cognitive processes depend on the whole living body in its practical and skilled engagement with an environment of affordances.

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