

A model of consciousness and attention aimed at speedy autonomous adaptation

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Abstract

An advanced model is proposed that can explain the function in short term adaptation. Associative temporal memory and the function of top-down attention are adopted in the model, in which consciousness and attention are defined as clearly different functions; consciousness is mainly defined as a process of learning as a whole system, and attention is defined as functions that quickly select resources with priority based on the information for learning. These functions work by complementing each other via associative temporal memory. As a result, consciousness and attention are explained as fundamental functions for an autonomous adaptive system to be efficiently and speedily adapted to an environment. Even though the model proposed here has a configuration similar to Global Workspace Theory (GWT) including Global Neural Workspace (GNW), it differs greatly from our model in its basic purposes and functions.

Keywords: model of consciousness, model of attention, autonomous adaptation, global workspace theory, associative memory

1 Introduction

Although consciousness itself is a complicated function, consciousness and attention form complicated relations. Kinouchi and his colleagues have indicated that consciousness involves basic functions of learning for an autonomous adaptive system to be adapted to an environment as a whole system. The main characteristics of consciousness, such as time delay in the experiment by Libet [1], unity, and phenomenal consciousness were explained through their studies (Kinouchi [2], Kinouchi et al. [3], Kinouchi and Kato [4]). However, although the previous model explained functions of consciousness in long term adaptation, this was insufficient to explain the function of consciousness in short term adaptation.

An advanced model is proposed in this paper that can explain the function in short term adaptation. Associative temporal memory and the function of top-down attention are adopted in the model, in which consciousness and attention are defined as clearly different functions; consciousness is mainly

defined as a process of learning as a whole system, and attention is defined as functions that quickly select resources with priority based on the information for learning. These functions work by complementing each other via associative temporal memory. As a result, consciousness and attention are explained as fundamental functions for an autonomous adaptive system to be efficiently and speedily adapted to an environment. Even though the model proposed here has a configuration similar to Global Workspace Theory (GWT) including Global Neural Workspace (GNW) (Baars [5], Baars and Franklin [6], Changeux and Dehaene [7], Dehaene and Changeux [8]), it differs greatly from our model in its basic purposes and functions.

2 Modeling Method

A. Basic design conditions

We assumed four basic design conditions for autonomous adaptation.

- (i) The system must autonomously adapt as speedily as possible to a complex environment without an external teacher. This means that it must learn from its own experiences that consist of sequential perceptions, actions, and rewards in the environment as quickly and effectively as possible.
- (ii) The system must have a learning control function that varies the system configuration itself based on a value evaluation mechanism, such as reward and punishment.
- (iii) Artificial neural nodes must mainly be implemented in the system.
- (iv) The system must reduce as many of its resources as possible, such as the nodes and energy used by the system itself.

B. Basic configuration

The basic configuration is outlined in Fig. 1. The four main characteristics are presented below.

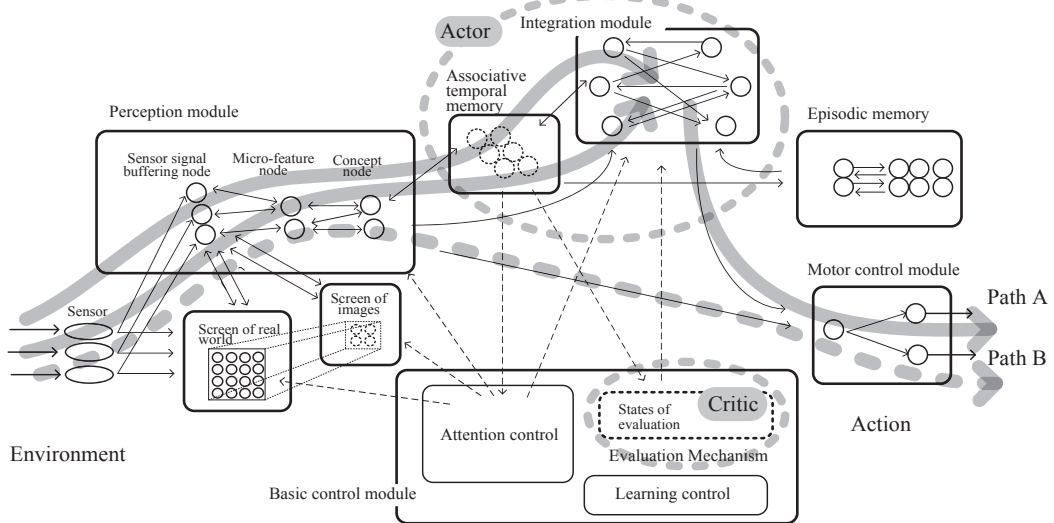


Fig. 1 Basic configuration for system

- (i) Many processing flows are executed in parallel, and each flow is executed as quickly as possible.
- (ii) Important objects and appropriate actions are concurrently selected by the actor in one operation.
- (iii) The motor control module immediately drives motors on the basis of the decision from the actor. Learning activities in the system are simultaneously carried out.
- (iv) These activities are controlled by the basic control module.

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