



# Color Vision Consciousness System Capable of Additionally Learning New Knowledge

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## Abstract

The authors have successfully developed a consciousness system capable of autonomously increasing its knowledge by simply connecting that additional knowledge to the system. In this approach, the system always learns anew, and does not utilize the relearning method typical of conventional neural networks. Experiments proved that this consciousness system provides almost the same color vision capability as a human.

*Keywords:* Consciousness System, Additionally Learning, Unknown, MoNAD, Color Vision

## 1 Introduction

The authors have attempted to implement an advanced function of human consciousness by using MoNAD consciousness modules in a layered structure and based on a watch-and-learn function. (Donald, 1991) (Gallese, 1996) (Takeno, 2011)

In this attempt, we focused on the human capability of “learning unknown information.” This means that, when unknown information is presented to the input unit of consciousness system, the consciousness system autonomously learns this unknown information and automatically builds up its knowledge. This capability can be implemented by comparing and examining the difference between the new cognitive information output as the result of the information input to the MoNAD with the previous cognitive information stored in the MoNAD. When this difference is negligible, the information can be considered to be already known, because it means that the information was well converged. If the difference is not negligible, the information can be considered to be unknown. (Akimoto, 2010) (Kushiro, 2011) This paper shows, in the first place, that we have developed a capability that enables the consciousness system to determine whether the presented information is known or unknown by checking its own status. If this information is judged to be unknown, then the consciousness system learns it as a consciousness unit created and gains the new knowledge. Also we devised a mechanism in which the consciousness system can build up its knowledge automatically by connecting this unit to the existing system as a network element. Lastly, we conducted experiments on the color vision learning process of the consciousness system, and examined what cognitive capability the system gained in relation to its color vision.

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## 2 Consciousness system capable of additionally learning unknown color vision information

Figure 1 is a model diagram of the proposed consciousness system. In the Reason Subsystem, R1 is the MoNAD that has accomplished the initial learning. R2 through R21 are the MoNADs reserved for additional learning of unknown information. These are sometimes called “additional MoNADs.” The number of additional MoNADs is not limited. In the Emotion&Feelings Subsystem, P and UP represent “pleasant” and “unpleasant” respectively. The MoNAD represents “pleasant” when known information is given as an input, or otherwise it represents “unpleasant.” AS is the MoNAD of the Association Subsystem which transmits the signal to prompt R2 and subsequent additional MoNADs to learn.

The information flow in the consciousness system is as follows: First, a piece of information is input to R1 of the Reason Subsystem. The variation of the cognitive information is calculated in order to determine whether this is known information or unknown information (Fig. 1(a)). The information is judged to be known when the variation is above the value “Dis,” and judged to be unknown when the amount is below “Dis.” The value “Dis” is a threshold derived from experiments. We used 0.95 as this value. This result is transferred to the Emotion&Feelings Subsystem and, through P and UP, “pleasant” is represented when this is known and “unpleasant” when unknown. Then, this result is transferred to the Association Subsystem (c).

When “unpleasant” (unknown information) is represented, the Association Subsystem sends a signal to R2 and the subsequent additional MoNADs to prompt them to learn that information (d). These additional MoNADs send “learning-completed” signals to the Association Subsystem when they have finished the learning (e).

When “pleasant” is represented for the information, the MoNAD in “Shouki” status in the Reason Subsystem outputs a variable corresponding to the behavior (f). Here, “Shouki” means a status where an individual MoNAD is converged well to a representation and a behavior can be decided. These processes allow for the learning of unknown information.

When unknown information is input but the consciousness system judges it to be known, the process advances as follows: In the context of the present study, it means that the judgment of a human in regard to color vision is different from that of the consciousness system. In this case, the signal “this is not known information” is sent from the external environment (by a human) in order to force the system to judge it to be known and to learn it.

After the unknown information has been learned, the information flow in the consciousness system is as follows: First, in the Reason Subsystem, the input information is given to all the MoNADs (g), i.e., the initial MoNAD R1 and the subsequent additional MoNADs beginning with R2. Then, the cognitive information is calculated for every additional MoNAD including R2. When the value (cognitive information) exceeds “Sh” in more than one MoNAD, the MoNAD with the largest value is considered to be “semi-self-aware.” The term “semi-self-aware” may be simply called “SSA.” That information is transferred to the Emotion&Feelings Subsystem to represent “pleasant” (h). The value “Sh” is a threshold derived from experiments. We use 0.6 as “Sh.”

Also when there are several maximum values, the semi-self-aware status is given to the latest additional MoNAD among them, and that information is transferred to the Emotion&Feelings Subsystem. In other words, the priority order of “Shouki” for the MoNAD transmitting the information from the Reason Subsystem to the Emotion&Feelings Subsystem is “R21>R20> ... >R2>R1.” This means that this process puts a higher value on new knowledge than on old knowledge.

When there is no MoNAD whose output value is higher than “Sh,” no “Shouki” status exists in R2 and the subsequent additional MoNADs. Therefore, the consciousness system examines R1 for “Shouki” status. If R1 is in “Shouki” status, it is regarded to be “semi-self-aware” then that information is transferred to the Association Subsystem(b), and the behavior corresponding to the R1 representation is selected as the output from R1 (f).

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