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Content with Causal Complexity

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Internal representation and causal relations have been generally taken as polemically contrasted in the cognitive architectures. Representation bears content; whereas, a causal line does not, which at best can be seen as its (the representation's) implementation. In discussing the nature of a certain type of low-level processes, such as those in the Watt Governor, that they are 'mere transition of forces' is taken as a reason to deny the existence of an immanent role of representation (Haselager *et al.* 2003). To think of it more sympathetically, causal complexity and content together can be seen as two separate strands to be reconciled (Wheeler and Clark 1999). The possibility of *content with causal complexity* has rarely been considered, as it is not easy to figure out a substantial sense of content bound intrinsically with the complexity of a causal line.

As an attempt, Bechtel (1999) argues that there is a legitimate sense of representation immanent in the control of the Watt Governor. The reason of its existence is grounded on the isomorphism between representation and the machine states. Such a reason, however, is challenged by Haselager *et al.* (2003) that it is risky to incur overwhelming representations. A problem facing a loose account of representation is "how a system can be shown not to be representational" (Haselager *et al.* 2003, p. 18). This paper will present a sense of content with causal complexity but avoid the aforementioned problem of overwhelming representations.

It is easy to understand that the content of intentional states *arises from* machinery with causal complexity, yet this is not the attempt of this paper. Alternatively, in this paper I will make clear the existence of a type of content that is immanent in the dynamic states of certain complex cognitive processes, with those states being possibly scattering across intentional states or spreading across a line of cognitive control. Such a special type of content can be named *dynamic content*.

Sub-symbolic Features with Complex Connections

Consider two examples of dynamic content. Firstly, units of the connectionist network represent certain sub-symbolic features, according to Smolensky (1988), which together represent intuitive cognitive content. Consider the role of sub-symbolic features in the representation of those units. Those features interact mutually under the connecting control of the connectionist network, with various weights in different between-units connections and certain algorithms controlling the activation of units. When the information transformation is in process, the network has

not yet presented clear intentional (possibly conscious) content, but those sub-symbolic features really undergo transformation. That network, meanwhile, is by no means empty (though possibly unconscious) in its maintenance of cognitive features. The envisaged content, unlike the higher-level content manifested in the output layer, does not pertain to a cognitive state under a functional analysis. Rather, its nature causes it exist *in process*.

Motor Control

Secondly, motor control is the paradigmatic example of *dynamic content*. Dynamic content is conceived of as consisting of standing-ins of a system that serve as *guidance of that system's behavioral control*, and in turn as a way to supply the maintenance (with its causal power) of that system's performance in its environment with a certain degree of flexibility. Those standing-ins work systematically under a scheme which is non-isomorphic but can engage external conditions. Those standing-ins qualify the system as content-bearing because they enhance its capabilities of performance. The role of standing-ins in the constitution of content is to provide mediating entities for the systematic use in the course of behavioral generation.

A system's dynamic content *qua* content, as we can see, rests on the amenability of its behavioral guidance in the light of enhancing its performance. Because the amenability is a capacity of fine-tuning the causal connections of a system's complex behavioral control, dynamic content qualifies as content on grounds of its potentiality of amending complex causal connections.

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