Sensorimotor theory and enactivism

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Abstract. The sensorimotor theory of perceptual consciousness offers a form of enactivism in that it stresses patterns of interaction instead of any alleged internal representations of the environment. But how does it relate to forms of enactivism stressing the continuity between life and mind (and more particularly autopoiesis, autonomy, and valence)? We shall distinguish *sensorimotor enactivism*, which stresses perceptual capacities themselves, from *autopoietic enactivism*, which claims a necessary connection between experience and autopoietic processes or associated background capacities. We show how autopoiesis, autonomous agency, and affective dimensions of experience may fit into sensorimotor enactivism, and we identify differences between this interpretation and autopoietic enactivism. By discussing artificial consciousness we further sharpen the distinction between sensorimotor enactivism and autopoietic enactivism. We argue that sensorimotor enactivism forms a strong default position for an enactive account of perceptual consciousness.

1 SENSORIMOTOR THEORY

Sensorimotor theory makes a constitutive claim: perceptual consciousness is constituted by the exercise of sensorimotor capacitie [9]. In this paper we discuss how the theory relates to forms of enactivism stressing the continuity between life and mind, and more particularly autopoiesis, autonomy, and valence (e.g., [11]). We shall distinguish *sensorimotor enactivism* from *autopoietic enactivism* and we discuss whether, given a focus on capacities, there are reasons to embrace autopoietic enactivism.

1.1. Perceptual capacities

Perceptual consciousness, sensorimotor theory claims, lies in the exercise of perceptual capacities, not in any internal representation or dualistic 'je ne sais quoi' that may be thought to accompany them.

A perceptual capacity should be understood as the capacity for being attuned to aspects of an obtaining sensorimotor situation, that is as having mastery of the current sensorimotor dependencies linking possible actions and resulting changes in sensory input.

Note that patterns of sensorimotor dependencies can be defined at various levels of abstraction. For example, some patterns are already present at short timescales, concerning immediate sensory consequences of movement, while others are only actualized in the extended exploration of objects [6]. It is often far from evident which patterns we engage with, as can be seen for example in [10] analysis of some patterns relevant to color vision.

Note also that capacities develop and change gradually over time. To explain *which* sensorimotor dependencies we are attuned to, we must therefore consider the history of our sensorimotor interactions. Biases in action as well as bodily and environmental constraints create biases in the occurring sensorimotor dependencies, thereby affecting the sensorimotor dependencies that an agent, be it biological or artifical, has the opportunity to become attuned to.

1.2. Conscious experience

Sensorimotor theory claims that the particular *quality* of experience, e.g. what makes an experience the experience of red, lies in particular patterns of sensorimotor engagement. But a further question can be asked about the conditions under which we can we speak of conscious experience at all. Merely having a perceptual capacity doesn't imply consciousness (as an example, take the sensorimotor capacity of a missile guidance system). Consciousness additionally requires that the sensitivity to the environment should potentially be useable in (rational) planning, thought, and in the case of typical human adults, verbal report [9, 8].

In humans, verbal report and the acting out of plans based on our experience *expresses* conscious experience. However, intuitively at least, adding a capacity for verbal report or planning to a machine doesn't suffice for us to be willing to ascribe consciousness to the machine, certainly not as long as the range of capacities remains severely restricted. It would seem that something more is required before we would speak of conscious experience; what could this be? Could it be simply more perceptual capacities, or do we need non-perceptual capacities such as the self-producing capacities of living organisms that (unlike planning, thought, or speech) do not *express* the perceptual capacities.

In the next section we shall introduce autopoiesis, and two kinds of enactivism making different claims about which are the relevant capacities for speaking of conscious experience.

2 LIFE-MIND CONTINUITY: AUTOPOIESIS IN TWO KINDS OF ENACTIVISM

Within a broadly enactive approach, mental phenomena are considered to be an aspect of our lives as biological organisms (e.g. [4, 11, 12]) To understand human mental phenomena is to understand the way our living bodies engage with the environment.

2.1. Autopoiesis

A central concept in many enactive theories is *autopoiesis* [5]. Living organisms are spontaneously active, self-maintaining and self-producing systems, and it has been proposed that we should understand our phenomenology in light of this self-creating or 'autopoietic' organization. More particularly, an organism lives under precarious conditions – without its activity, its organization breaks down – the organism must adapt to the environment in order to continue its autopoietic organization [2, 3]. The more sophisticated forms of human mental life, including

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our most advanced perceptual capacities, may be considered as extending our basic adaptive autopoietic activity.

2.2. Sensorimotor enactivism and autopoietic enactivism

Autopoiesis can be considered as a kind of interaction with the environment, but how does it relate to consciousness? In particular: *which* (interactive) properties of a system are relevant for the ascription of consciousness.

We distinguish two mutually exclusive kinds of enactivism, which we define as follows:

Sensorimotor enactivism puts only perceptual capacities center-stage, by claiming that perceptual consciousness can be understood without further appeal to factors outside the domain of perceptual interactions. Autopoietic processes are then only relevant for perceptual experience in so far as they impact on the perceptual capacities themselves.

Autopoietic enactivism puts autopoietic processes center-stage, potentially relegating perceptual capacities to a secondary role. More specifically, autopoietic enactivism claims that there is a *necessary* connection between conscious experience and autopoietic processes or associated background capacities. On this view, to explain perceptual consciousness we have to appeal to factors outside the domain of recognizably perceptual interactions.

Which of these enactivisms forms the best framework for understanding consciousness? A good way to proceed for answering this question, we suggest, is to take sensorimotor enactivism as the default position, to investigate what if anything is missing. After all, sensorimotor enactivism appeals to a more restricted range of processes compared to autopoietic enactivism, so that we may ask what the latter has to offer that the former hasn't.

3 AUTONOMOUS AGENCY, AFFECTIVE EXPERIENCE, AND ARTIFICIAL CONSCIOUSNESS

We shall explore potential reasons to embrace autopoietic enactivism by discussing views on autonomous agency, affective dimension of experience, and preconditions for artificial consciousness.

3.1. Autonomous agency

Part of the motivation for the emphasis on life comes from an interest in *autonomous agency* and associated cognitive/behavioral capacities. The idea is that living organisms (or adaptive autopoietic systems) have the kind of organization allowing for robust forms of autonomy [11, 2].

Reasons can be found in the literature supporting the view that, based on our autopoietic organization, we are autonomous in a fairly strong sense. However, we point out that this does not support autopoietic enactivism as long as no support is given to the claim that such strong autonomy is *necessary* for perceptual consciousness. From the perspective of sensorimotor theory, autonomy may play a role in explaining the development of our sensitivity to sensorimotor dependencies. It does not however support the idea that perceptual consciousness is co-constituted by extra-perceptual capacities specifically associated with autopoiesis.

3.2. Affective dimensions of perception

Various authors have suggested that affective aspects of perception may necessitate an appeal to factors outside the range of perceptual sensorimotor capacities (e.g. [1]). Affect, and valence, has often been brought in connection with autopoiesis. Living organisms display a certain 'concern' for their own persistence, which may be considered a precursor for more advanced forms of concernfulness characteristic of our mental lives [4, 2, 11].

We discuss ways in which also affective aspects of experience may get their place *within* sensorimotor enactivism. Starting from the fact that sensorimotor dependencies can be defined at various levels of abstraction, we discuss our sensitivity to affective aspects of stimuli. We show how these may get a place in an account of valence and affective aspects of experience, without the need to appeal to extra-perceptual interactions.

3.3. Artificial consciousness: what the missile guidance system lacks

Does artificial consciousness require artificial life or autopoiesis? And if so, why? Consider a missile guidance system that is attuned to sensorimotor dependencies, such as the way in which its 'view' of a target airplane changes when it moves, allowing it to home in on the airplane [9]. While the missile with guidance system can be said to exercise its sensorimotor capacities, we do not ascribe conscious experience to the system. What does the system lack?

Thompson ([11]: 260-261) reveals commitment to autopoietic enactivism by appealing to a lack of life to explain the lack of mind of the missile guidance system. Noë ([7]: 229-231) makes similar claims but these may remain open to other interpretations.

We suggest that, as both the range of perceptual capacities, as well as the range of ways to express these capacities, are severely restricted in the case of the missile guidance system – as well as in (most) present-day robots – we need not appeal to anything beyond these perceptual capacities to distinguish us from the machines. Thus we argue that the relevant differences separating us from the machines may be spelled out within sensorimotor enactivism.

Sensorimotor enactivism offers a general framework for thinking about perceptual consciousness, applying both to living organisms, as well as potentially to non-living artificial systems. On this view autopoietic organization, although relevant in living organisms, may not be necessary for perceptual consciousness.

4 CONCLUSION

How does sensorimotor theory relate to other forms of enactivism stressing the continuity between mind and life (and autopoiesis, autonomy, and valence)? Two frameworks have been sketched. In *sensorimotor enactivism*, autopoiesis may be relevant for understanding how the development of perceptual capacities occurs, but it is the perceptual capacities themselves, and not the link with autopoeisis that constitutes experience. In *autopoietic enactivism*, by contrast, our perceptual capacities are *only* relevant to conscious experience in virtue of a larger set of capacities characteristic of our autopoietic organization. In particular, genuine concernful conscious engagement, as characteristic of our affectively laden experience, is under this view thought to depend constitutively on perception being

grounded in autopoietic organization. Having discussed and rejected reasons for favoring autopoietic enactivism, we conclude that without further reasons favoring autopoietic enactivism, sensorimotor enactivism forms the default capacities-oriented form of enactivism.

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