LETTER

Avoid the hard problem: Employment of mental simulation for prediction is already a crucial step

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Barron and Klein (1) highlight the importance of a simulation-based account of planning ahead as a central mechanism to allow for basic cognitive properties. They relate this on a functional level to a detailed architecture of central circuits in the human midbrain. As a major contribution, they further compare these structures with functionally similar ones in the insect brain. They assume that central to both structures is an integrating and predictive model of the body, including aspects of the environment. Therefore, they conclude that the ability to plan ahead, using such a body model for internal simulation, is not unique to humans or vertebrates, but is a more general and older principle already present in some invertebrates, particularly insects.

They further relate the concept of internal simulation to the notion of consciousness, and particularly to subjective experience. From our point of view, mental simulation and relating oneself to the environment are certainly requirements for phenomenal consciousness. However, it is not shown in any way that these capabilities necessarily lead to subjective experience. Therefore, in our view, the article is not contributing to the discussion of subjective experience. Instead of trying to argue on this slippery ground, we propose to leave aside completely the question concerning subjective experience, which Chalmers characterizes as "the hard problem" (2). Instead, we should focus on a description on the functional level, which allows us, following Cleeremans (3), to divide consciousness into access consciousness and reflexive consciousness. Importantly, this approach matches well with the functional view of Barron and Klein (1) without the need to use the concept of subjective experience.

Following such an approach provides a functional and testable account of parts of consciousness. Here, we agree that this can already be found in quite simple systems. Modeling approaches can be used to test for such emergent properties. As one example, we modeled an insect-based approach for walking that reflects, on a detailed level, behavioral and, to some extent, neurophysiological findings, including action selection on different levels of the reactive system (4). When this approach was extended to include a functional model of the body in relation to the environment, the system was shown to allow for planning ahead (5) and, as we argued in detail, fulfilled the basic conditions required for access consciousness (3). In this way, such an insect-based model constitutes a functional description for access consciousness without the need of discussing the concept of subjective experience, but it is still well in agreement with the core mechanism described by Barron and Klein (1). Our computational approach (5), which is currently being implemented on a physical robot to validate these hypotheses, shows that one requirement is the ability to decouple the body model from the motor output. Secondly, the model has to be manipulable. Even though these requirements only introduce small changes into the insect-based systems, they have, to date, not been shown in insects. Correspondingly, a central "metric place" is not required to describe the navigation behavior known from central-place foragers (ref. 5 and references therein).

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