

# Three experiments to test the sensorimotor theory of vision

Commentary on:

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**Abstract:** The sensorimotor theory of vision is the best attempt yet to explain visual consciousness without implying a Cartesian theatre. I suggest three experiments which might test the theory.

If we were thinking clearly about consciousness we should surely have crossed James's (1890) "fathomless abyss" by now, but we have not. I agree with Dennett (1991) that the root cause of our confusion is the seductive lure of the Cartesian theatre (CT) (that mythical place where consciousness happens; that imaginary container of the "contents of consciousness." Most existing theories – though their proponents deny it – entail some form of Cartesian theatre. Global workspace models do so, as do most current attempts to find the neural correlates of consciousness. Put at its simplest (and perhaps most extreme) we can say this. Ask the question "what is in my consciousness now?" (Or "what is in x's consciousness at time t?"). If you believe there is an answer then you are imagining a Cartesian theatre.

O'Regan & Noë (O&N) provide the best attempt yet to escape from the clutches of the CT. Their theory is exactly the kind of bold departure that is needed. But is their theory right? And do they go far enough?

O&N suggest that "it is not possible to subject a general framework to direct verification." However, I think some of their central claims can be tested and I offer here three suggestions for doing so. These are not easy tests to perform but I hope they may reveal how different are the predictions of this theory compared with other, more traditional, theories of vision and visual awareness.

1. Scrambled vision. Traditional experiments using inverting goggles show that people gradually learn to see the world "the right way up," but during the learning phase they suffer two competing views, as described by O&N. We might imagine that in some way they gradually learn to invert their mental picture of the world. In the proposed experiment people would wear goggles that completely scrambled the visual input (this scrambling might also include blind spots, bars, or other gaps without affecting the argument). If O&N are correct, the new sensorimotor contingencies should be no more difficult to learn than with a simple inversion, but this time the subjects would effectively begin their learning blind. Their visual input would appear as noise and they would see nothing meaningful at all. As they learn the new contingencies by visual manipulation they would gradually come to see again. This new seeing would, if the theory is correct, be experienced as just like ordinary seeing. I would love to know what it is like to learn to see and would happily volunteer for such an experiment.

2. Manual vision. The feelings associated with facial vision in the blind might, in the spirit of O&N's theory, occur because the sensorimotor contingencies of the face and ears are linked. That is, moving the ears necessitates moving the face. In this experiment auditory feedback is provided while subjects try to detect virtual objects in front of them by manually controlling the position of virtual ears. They could then move their faces independently of moving their "ears." In this case the theory predicts that they would feel things not on their faces but on their hands.

3. Blinded vision. Phenomena such as habituation and stabilised retinal images usually prompt only

the conclusion that the visual system needs changing input to function. O&N, in contrast, propose that active manipulation of sensorimotor contingencies is required. This difference could be tested by yoking pairs of subjects together in the following way. 'A' subjects are able to move their eyes normally and explore a visual scene. 'B' subjects are given exactly the same changing visual input but their own eye movements are ineffective and uncorrelated with the input they receive. O&N's theory makes the strong prediction that 'A' subjects will see normally, but 'B' subjects – while receiving identical visual input – will be blind.

These tests, especially the last, might help find out whether O&N's bold theory really holds or not. If it does they will have made a huge step towards eliminating the CT since in their theory seeing is a way of acting, not a way of building up unified representations of the world – or pictures in the CT. And incidentally (though they do not mention this), it may also explain the currently mysterious profusion of descending fibers in the visual system.

Nevertheless, their attempt is not, I suggest, completely consistent. For example, they claim (in sect. 2.6) that visual awareness requires not only mastery of the relevant sensorimotor contingencies but integration of this with thought and action guidance. There are possible counter-examples in both directions. First, fast actions that are controlled by the ventral stream are not normally reported as conscious (Milner & Goodale 1995) yet they should surely count as "action-guidance." This step is particularly odd since they helpfully point out problems with Milner and Goodale's analysis in section 8.5.3. Second, experience in meditation suggests that it is possible to stop all thought, planning, and overt action (if not sensorimotor manipulation) without losing vision.

Finally, a few subtle hints of the CT remain – showing just how hard it is to escape altogether. Such phrases as "features of the car enter consciousness" or "are available in consciousness" (sect. 6.2) imply a CT, as do the claims that some sensorimotor contingencies are "accessible to awareness," or are "brought into conscious-ness" (sect. 6.6). And there seems to be some confusion in the way they compare their views with Dennett's. While claiming that "qualia are an illusion" (sect. 6.3) and "the conception of phenomenal consciousness itself must be. . . rejected" (sect. 6.9), they nonetheless take Dennett to task for being "insufficiently attentive to the actual phenomenology of experience" (sect. 7.3). Yet, as Dennett famously says: "the actual phenomenology? There is no such thing" (Dennett 1991, p. 365).

Building a theory that does justice to the reality of consciousness without invoking a CT is extremely hard. I think O&N, in spite of these small problems, have come closer than anyone else. Their theory is bold, testable, and a rare step in the right direction.