Rev.Phil.Psych. (2012) 3:89–108
DOI 10.1007/s13164-012-0090-7

Discussion of J. Kevin O'Regan's "Why Red Doesn't Sound Like a Bell: Understanding the Feel of Consciousness"

J. Kevin O'Regan · Ned Block

Published online: 8 March 2012

1 Summary of the Book, by J. Kevin O'Regan

The book (O'Regan 2011) attempts to provide an account of phenomenal consciousness. It starts by discussing the perceived *quality* of sensory experiences, without adjudicating on what makes them actually experienced, let alone conscious.

What I call the "sensorimotor" approach contends that the quality of a sensory experience is a set of objective laws concerning the interaction with the world that the experience involves.

The quality of red, for example, is completely determined by objective laws that link our actions to the sensory changes that they produce (e.g. how moving our eyes, moving pieces of red paper, etc. change the sensory input deriving from the light coming into our eyes). The quality of auditory experience is completely determined by laws like the fact that when you approach a sound source, the amplitude of the sensory input increases, etc.

Now there are a very large number of objective laws characterizing any individual sensory interaction with the world, and the laws themselves can be expressed in many ways. Because humans have limited cognitive resources, we cannot have cognitive access to all these laws. Applied to the case of red for example, when we see a red surface and move it around under different lights, the brain codes a subset of the laws that apply, and it registers that they are particular, previously encountered laws. But we as persons do not have cognitive access to these laws. We do however have access to the fact that the particular laws that apply are laws that we as persons have categorized as being the laws of red, rather than say, of green. Furthermore we as persons simultaneously have cognitive access to additional facts such as the fact that

J. K. O'Regan
Laboratoire Psychologie de la Perception, CNRS - Université Paris Descartes,
Centre Biomédical des Saints Pères, 45 rue des Sts Pères, 75270 Paris cedex 06, France

N. Block (✉)
Departments of Philosophy, Psychology and Center for Neural Science, New York University,
5 Washington Place, New York, NY 10003, USA
e-mail: block.ned@gmail.com

the experience is going on now, that it is truly sensory, and that it is visual (since, in addition to being tuned to the redness itself, our brains are also tuned to the fact that closing our eyes will cause the stimulation to cease, or the fact that shifting our gaze causes typical visual flow-field displacements to occur, etc.).

This view provides a basis for explaining the perceptual structure of sensory qualities and their ineffability.

The view also explains why people say that there is "something it's like" to have a sensory experience: Certain objective properties of real sensory interactions are not possessed by mental activities like thoughts or imaginings, nor by autonomic processes in the nervous system. These objective properties of sensory interactions are those that I call bodiliness, grabbiness, insubordinatenss and richness. They provide sensory experiences with, among others, a quality of imposing themselves on us, of escaping our voluntary control. Together (and possibly with other objective facts) they plausibly amount to the quality of "something it's like".

What is now necessary for a sensory interaction to be *experienced* and to be *conscious*?

I suggest that usual usage of the phrase "having a sensory experience" allows, for example, that an absent-minded driver discussing with a partner should *experience* the red light where he stops, but without being *conscious* of it. To have a *conscious* experience seems to require two tiers of cognitive access. A first tier where the driver is making use of the fact that sensorimotor dependencies characteristic of red are currently being obeyed (this allows the driver to stop). And a second tier where the driver cognitively accesses that fact. Having a conscious sensory experience under this approach can thus be defined as having cognitive access to the fact that one has cognitive access to categories of sensorimotor dependencies that are obeyed by one's real engagement with the world. The experienced "what it's like" of the experience derives from objective aspects of this engagement (among them bodiliness, grabbiness, insubordinateness and richness) which indicate that the engagement is one with the real world and involves the real senses. The particular sensory qualities of the experience (red, green, onion-flavor, etc.) are constituted by further objective, sensorimotor laws. We can categorize these, but we do not have complete cognitive access to their details.

In summary, the sensorimotor approach is a way of defining phenomenal consciousness which dissipates its mysteries, while accounting for what people say about it. What is interesting is that this simple philosophical idea generates rich empirical predictions, also described in the book.

2 Introduction to Ned Block's Response

Kevin O'Regan's seminal 1992 paper on the world as an external memory and his 2001 seminal paper with Alva Noë are the founding documents of the sensorimotor view of conscious perception as an alternative to standard views of perception (O'Regan 1992; O'Regan and Noe 2001). But from the outset, the sensorimotor point of view has been accused of involving two incompatible perspectives. (See (Block 2005) on this point.) One perspective is that of conscious perception as an ACTIVITY: seeing is "something that the person *does*" (p. 29). On this perspective, instead of adopting a picture of "passive vision" as the paradigm, we should instead

adopt the picture of touch as active exploration as our model of perception. However, famously we have conscious experience in mental imagery and in dreams that can be very much like actual perceptual phenomenology. In response, sensorimotor theorists have said that, well, maybe actual movement isn't necessary: being poised to move is enough (p. 67.) Unfortunately for this idea, it is not clear that in imagery or dreaming one is poised to move as in real perception. However, the sensorimotor theorists have also had another idea: that it isn't actual movement or even being poised to move that is at the center of phenomenal experience but rather something more cognitive, knowledge or expectation: for example, knowing what stimulations will be received if one moves in a certain way. Let's call this cognitive access relation COGNIZING.

O'Regan's important book makes the daring move of embracing *both* of these perspectives, *but as theories of different things*. He holds that "sensorimotor laws"—laws of activity–constitute the qualities of the experience, e.g. what differs as between the sensory quality of audition and vision or what differs between the sensory quality of seeing red and seeing green, whether they are conscious or unconscious; and he takes cognizing to constitute what makes those qualities of experience conscious.

I will start the debate by arguing that this daring move does nothing to avoid the basic problem with his theory of sensory qualities, which is an obscurity on the issue of which sensorimotor "laws" are the ones that count. In particular, there is good reason to think that anything that could be called the "laws" of imagery, dreaming and unconscious perception are different from those of conscious perception. Further and most importantly, any attempt to answer the question "Which laws?" can only succeed by smuggling in the very conscious qualities to be explained.

2.1 Which Laws?

Let us start with imagery and dreams. Some sensorimotor theorists have tried to explain imagery in sensorimotor terms (Thomas 1999), but the only evidence I have seen offered for such a view is that visual imagery typically involves eye movements (and in the case of abacus imagery, hand movements), and deliberate eye movements can interfere with visual imagery. But this is *causation,* and it is quite a leap to conclude that these eye movements are constitutive of imagery. Visual imagery survives the loss of eyes and motor cortex. Perhaps vision and visual imagery often involves some motor imagery, but the physical basis of imagery is mainly in the perceptual system, not the motor system (Kosslyn et al. 2006).

Further, anything that could be called the "laws" of imagery and dreaming don't match the "laws" of perception. Take one example: Emmert's Law (Boring 1940). Stare intently at a red rectangle for a minute or two. Then look at a white sheet of paper. You will see a green rectangle of the same shape. If you move the sheet of paper away from you, the green rectangle appears bigger. If you move it closer, the rectangle appears smaller. Most people are quite surprised by this, presumably because the "law" is something like the opposite of what obtains in perception. The "laws" of perception that O'Regan mentions most prominently have to do with the consequences for stimulation contingent on motor responses, but those laws do not apply in imagery or dreaming, which at least in my case is kaleidoscopic and fantastical. (Turning one's head is as likely to manifest another object as another side

of the same one.) Does that show that the sensory qualities of perception are of a totally different kind from mental imagery or dreaming? I think not. Some people have very vivid imagery with substantial similarity to perceptual phenomenology, and unsurprisingly there is substantial overlap in perceptual systems between imagery and perception. Indeed, representations of imagery and vision can be superimposed with a resulting sensory and conscious composite (Brockmole et al. 2002; Lewis et al. 2010). Similar points might be made about dreaming.

At this point in the dialectic, some advocates of sensorimotor views (Noë 2004) have been known to shift the terms of the discussion, appealing to *expectations* that are common to imagery, dreaming and perception. I know that in perception, if I turn my head or my eyes, my sensory stimulation will shift in certain predictable ways. It is sometimes said that some version of these expectations apply in imagery and dreaming too, and that is what is in common that explains the common phenomenology. O'Regan seems to indicate an expectation account when he says (p. 66) "the dreamer implicitly "supposes" (in point of fact incorrectly) that if the eyes were to move, say, they would encounter more detail." The appeal to what the dreamer supposes shows we are not in the domain of ACTIVITY but rather in the domain of COGNIZING. Sensory quality whether conscious or unconscious is supposed to be explained by ACTIVITY, but the dialectical move I just considered replaces the appeal to ACTIVITY with an appeal to COGNIZING—which is supposed to provide, not a theory of sensory quality—such as those in perception or imagery– but a theory of what makes that quality conscious. So as a way of saving the sensorimotor view from the imagery and dreaming problems, this appeal falls flat.

Perhaps it will be said that Emmert's Law is not the "right kind" of law. But what is the right kind of law? Can the "right kind" of law be specified without appealing to the sensory qualities or their conscious appreciation? I think not.

Here is an example from Block (2005), one in a genre that O'Regan should have discussed: Mel Goodale and Kelly Murphy (Goodale and Murphy 1997) presented 5 rectangular blocks to subjects at various positions in the visual field ranging from 5° to 70° off the line of sight. They measured accuracy of perception of the blocks via a device that measured the aperture between thumb and forefinger as subjects reached out to pick up the block. The basic finding is that subjects' grip accuracy is roughly the same at 5° as at 70°, that is, constant across much of the visual field outside of the fovea, the central area of vision in which photo-receptors are very dense. By comparison, conscious perceptual discrimination is vastly worse (roughly one tenth as good by a standard measure) at 70° compared to 5°. Anyone can see the point for themselves. If you look straight ahead and try to discern objects at a 70° degree angle to the line of sight, you find that those objects are barely visible. But you can nonetheless pick them up fairly well. The underlying explanation is that conscious vision is overwhelmingly foveal, but the systems that guide action are more heavily weighted to peripheral vision. So some "laws" of perception that involve visually guided action are not part of the base which O'Regan supposes to specify sensory qualities. But which laws *are* part of that base? I don't see any way to specify them without appealing to a criterion based on conscious perception itself.

The problem of "Which Laws?" is further exacerbated by the fact that O'Regan's theory of "sensory quality" is supposed to apply to sensory qualities independently of whether the perception involved is conscious or unconscious. However, the "laws" of

conscious and unconscious perception can be quite different. Indeed, many paradigms find something like opposite behavioral effects of conscious and unconscious perception. To take one kind of example (Jacoby's "exclusion" paradigm (Debner and Jacoby 1994)), participants asked to "exclude" a response based on a certain stimulus do better than baseline if the key stimulus is conscious but do worse than baseline if the stimulus is unconscious.

In some cases, the representations of conscious and unconscious perception are different. But these representational differences are not explained by differences in sensorimotor interactions. Rather it is the reverse. A recent study (de Gardelle et al. 2011) contrasted conscious and unconscious face-representations using priming experiments involving morphed faces. Faces were morphed from one person to another, and members of the continuum were presented to participants either consciously or unconsciously. Participants had to make a binary decision—famous vs. not or American vs. French. They found that unconsciously presented faces were coded continuously whereas consciously presented faces were coded categorically. As they put it in their summary, their studies supported the view that at least with regard to faces, there is "a subliminal mode involving analog treatment of stimuli information, and a supraliminal mode relying on discrete representation." Now this is a case in which the difference between conscious and unconscious perception is in the *representations* of perception—analog vs digital. Of course those differences in kinds of representations will be reflected in differences in their sensorimotor relations but they do not *derive* from the sensorimotor relations. What is primary here is the *representations* of vision.

The points I have been making about the problem of "Which Laws?" are especially obvious when it comes to color-consciousness. O'Regan's theory of color consciousness is this: "the raw feel of a particular color is constituted by the abstract laws that govern the way surfaces of that color behave when we interact with them." Here is a challenge for O'Regan: what are the abstract sensorimotor laws that explain the commonality between a mental image of red and a perception of red? Appeals to dispositions won't work since as noted in connection with Emmert's Law, the relation between imagery and *actual* surfaces can be different from perception. And it is unclear how a relation to imaged surfaces can help since appealing to them would be to invoke our implicit knowledge of sensorimotor laws, not the laws themselves, thereby moving from the domain of ACTIVITY to the domain of COGNIZING.

What would be so bad about that though? Perhaps the way out would be to simply collapse the theory of sensory quality and consciousness of it together, appealing not to actual instantiations of sensorimotor laws (ACTIVITY) but instead to our implicit knowledge of them (COGNIZING)? But the problem of"Which laws?" infects a COGNIZING treatment of them as well. The issues I have been raising about the difficulty in specifying which laws without smuggling in the very notions to be explained is not at all aided by introducing a layer of cognition between the obscure laws and the cognizer.

3 Reply by Kevin O'Regan

Ned Block's criticism concerns what he thinks is an obscurity in the sensorimotor theory: he thinks the theory does not define *which are the sensorimotor laws* that determine sensory quality.

He takes a first example of imagery and dreaming. He says these provide very similar phenomenology to real seeing, yet the accompanying sensorimotor laws are very different. He says this is contradictory with the claim that phenomenology is constituted by the sensorimotor laws.

My view is that on the contrary, the sensorimotor laws that underlie imagery/dreaming, and (we shall see below) also afterimages, hallucinations and brain stimulation, explain *both the similarities and the differences* with real seeing.

Note first that the sensorimotor approach does not discount the sensory input itself. Retinal stimulation is obviously an essential component of visual perception. If I provide you with a tachistoscopic flash of retinal stimulation, you have convincing visual phenomenology, precisely because the occurring sensory input is very similar to what happens instant after instant on the retina as you look at things around you. But then if you move in some way and it happens that the laws that usually apply for real scenes do not actually apply, then you will see distortions and changes which you cognitively interpret to be impossible, and which allow you to conclude that you are imagining, dreaming, afterimaging, hallucinating or being subjected to some kind of brain stimulation.

Take a red afterimage. The excitation of retinal cones that causes the afterimage is similar to the excitation that is caused by looking at a real red surface. Furthermore, laws apply such as the fact that as you move your eyes, the changes in incoming neural input are similar to those that describe the changes in incoming neural input when you are *following a moving red surface*. That's precisely why red afterimages appear red and appear to move with your eyes. But the laws are also different in many ways: If you accommodate close or far, you get the well-known Emmert's law. This provides afterimages with their odd behavior of looking like real surfaces that shrink when you look close and expand when you look far. Afterimages also do not behave the same as real surfaces as regards blinks or changes in illumination: they change their intensity in peculiar ways not shared by real surfaces. As the afterimage fades, the activation and laws start resembling what would arise from surfaces whose color gradually fades and changes hue, precisely as afterimages are known to do. Thus the sensorimotor laws that describe afterimages precisely account for what they look like. They look like real surfaces with some odd properties: they move with your eyes, they obey Emmert's law, they fade and evolve over time.

Another example Ned Block brings forward to illustrate his problem is peripheral vision. He says that the sensorimotor theory would affirm that the quality of peripheral vision is determined by only a subset of the sensorimotor laws, namely those that govern the relative ability or inability to make detailed discriminations, and that this is what gives peripheral vision its "unclear" quality as compared to central vision. I agree that the phenomenology of seeing in peripheral vision involves not being able to discriminate fine details. But I'd say that the ability to accurately grip objects in peripheral vision is *also* part of the quality of seeing in peripheral vision. It is also: being able to walk along the road without looking down and yet easily navigate curbs, puddles and irregularities, and to go through doors without knocking your elbows against the door-posts. *All* these laws are part of what seeing in peripheral vision is like.

In other words, in the sensorimotor theory, all the laws that the brain is tuned to, i.e. that make a difference in the organism's behavior, are what determine phenomenology.

It is this appeal to all the laws that allows me to account for both the similarities *and* the differences between real seeing and imagery, dreaming and unconscious perception.

Because Ned Block thinks I have a problem with the question of which sensorimotor laws determine phenomenology, he asks whether what he calls COGNIZING might be what is selecting the correct laws.

First, what I have said above shows that there is no problem with the question of "which laws", so there is in any case no need to appeal to COGNIZING. But second, I wish to clear up what seems to be a misunderstanding by Ned Block about the role of COGNIZING in my theory.

The sensorimotor laws I refer to and that determine the quality of experience are registered by the brain, but they are not available as such to the first person observer, who thus cannot COGNIZE about the content of the laws themselves. Mechanisms in the brain are tuned to the laws in the sense that they can categorize and recognize them as pertaining to known categories (e.g. "red", "soft"), and can make use of these categories in determining the person's behavior. But first person COGNIZING can only concern descriptions of sensorimotor laws constructed from cognitively available categories available to the person. Examples may be descriptions like "I know the sponge is soft because if I press, it squishes"; or "I have no name for this shade of red". Such descriptions do not constitute the raw quality itself of the experience. In my theory, COGNIZING only determines the mode and degree to which one is aware (or conscious) of the experience.

To make this clearer, let me illustrate the independent contributions of what Ned Block refers to as ACTIVITY and COGNIZING to three categories of visual experiences:

(a) Brain stimulation, afterimages, strong visual imagery and hallucinations: here, through some external or unusual influence, or perhaps through practice in visual imagery, brain systems come to be activated in a way which is very similar to how they are activated in normal seeing. As a result, we have the phenomenology of normal seeing. We have this veridical phenomenology until actions that we undertake (e.g. moving our eyes, blinking…) prove that the sensorimotor laws are in fact not those of normal seeing. At that point we continue to have phenomenology that is *similar* to that of normal seeing, but that corresponds to objects that are "odd", or impossible (like things shrinking and expanding depending on where we accommodate, or not disappearing when we close our eyes). So much for the *quality* of the experience involved.

    Then, in addition to the above, the *cognitive* component of perception can also kick in. We can become conscious of the experiences; we can become aware of their oddity or impossibility; and we can say to ourselves that we must be hallucinating, etc.

    (Note there is no threat for my theory from findings of the type observed by Brockmole et al.: neural activations involved in imaging and real seeing could overlap and cause mutual enhancement).

(b) Dreaming: here there may also be creation of brain activation that is similar to real seeing, as in (a). But the cognitive component that would usually kick in to say that we are not *really* seeing may not be functioning normally. Our epistemic

standards may be lowered, and we may continue to believe that we are perceiving veridically when we are in fact not.

(I do concede that there is ambiguity in the quote that Ned Block takes from me: I say "the dreamer implicitly "supposes" (in point of fact incorrectly) that if the eyes were to move, say, they would encounter more detail." I do not mean that the dreamer is incorrectly COGNIZING each of the sensorimotor laws. I mean that the dreamer is COGNIZING the fact that sensorimotor laws apply when they do not in fact.)

(c) Weak visual imagery: In this case the brain activation may be less similar to real seeing. A person may simply activate *cognitive* components of, say, redness – mustering mental associations, or knowledge about surfaces known to be red. Here the sensorimotor laws involved in real seeing would not be registered as applying, and the raw sensory "presence" of the image would be non-existent. The experience is more like thinking.

In other words, the phenomenology of experience is determined by all the sensorimotor laws that make a difference to the organism's behavior. Then, whether an experience is conscious or unconscious is a matter of the mode of cognitive access, and is independent of the sensorimotor laws involved. For example, how people behave in a Jacoby-type exclusion paradigm or in the de Gardelle et al. experiments is a question of modes of cognitive access, and which determine degrees of consciousness. But this is orthogonal to the raw sensory aspect of the stimulations involved, which are determined by the sensorimotor laws.

A final note: perhaps part of the problem in understanding my account comes from the fact that people don't usually distinguish "consciousness" from the "something-it's like", or "presence" of sensory experiences in the way I do. For me, these are two quite separate things. Consciousness is a certain higher-order mode of cognitively accessing one's experience. This is entirely independent of whether the experience has (sensory) "presence" or "something it's like", which is determined by aspects of the sensorimotor laws such as their bodiliness, grabbiness, insubordinateness and richness.

4 Reply by Ned Block

I issued a challenge to Kevin O'Regan: what are the sensorimotor laws that explain the commonality in sensory quality between a mental image of red and a perception of red. O'Regan tries two different tacks in his response, one of which is inadequate on its face and the other of which is more than adequate, but *abandons the sensorimotor approach*. The inadequate response is the appeal to "laws" that have to do with input, as appear in his discussion of activation of cones, moving your eyes, following a moving surface and the like. Voluntary ("strong") mental images and dreams don't require any specific input so these "laws" cannot explain the commonality between perceptions, images and dreams.

The more than adequate response comes in O'Regan's appeal to common brain activation, for example, "brain systems come to be activated in a way which is very similar to how they are activated in normal seeing. As a result, we have the phenomenology of normal seeing." OF COURSE! Theorists who believe in an

account of the nature of conscious experience in terms of its neural basis in the brain like myself (Block 2009) or Victor Lamme (Lamme 2004) would agree, but how can a sensorimotor theorist agree? O'Regan is committed to *sensorimotor laws common to perceiving red, imaging red and dreaming of red, that explain the common conscious qualities and those laws have to be different from laws that explain what is common to perceiving, imaging and dreaming of green*. O'Regan's reply looks like a move to a different theory, not a defense of a sensorimotor account.

One caution: O'Regan blurs the distinction between genuine input to color vision and the neural basis of color vision when he says "the changes in incoming neural input are similar to those that describe the changes in incoming neural input when you are *following a moving red surface*." Speaking of "neural input" in this way, blurs the distinction between the input in the sense of irradiation of sense organs or even the product of sensory transducers on the one hand and the neural basis of the experience itself on the other. In the case of color experience, the neural basis of the experience itself is probably to be found in V4 and V8, whereas the sensory transducers are in the retina. To extend the notion of 'input' so that it includes the brain realization of the sensory experience itself is just disguised capitulation.

So I reissue my challenge, slightly elaborated: *name a single genuine sensorimotor law that is in common to a perception of red (but not green), a voluntary imaging of something red (but not green) and a dream as of something red (but not green) that can help to explain the overlap in sensory quality that can occur among the experiences as of red*. And I think we should all realize that appeal to the neural basis of these experiences is not a defense of the sensorimotor approach.

5 Reply by Kevin O'Regan

Ned Block thinks that my appeal to neural mechanisms is a "move to a different theory, not a defense of a sensorimotor account". He makes this mistake because he assumes that neural mechanisms have the same status in his and my accounts of phenomenal experience. But they do not.

In Ned Block's account, local neural mechanisms (e.g. in V4 and V8) are assumed in some way to underlie the experience of red. Under such a view, if imaging red involves similar mechanisms to those that normally create the sensation of red, then OF COURSE we experience red during imaging of red, says Ned Block.

In my account, such local neural mechanisms do *not* underlie the experience of red, at least not directly. They can however contribute to enabling a person to engage with the environment in a way that obeys the laws of red. When that happens, the person is experiencing red. If imaging activates similar mechanisms to those normally involved when the person is interacting in this way, then the person must have the impression of interacting in a similar way and will be experiencing red.

The difference is perhaps subtle, but very important.

In Ned Block's view of the role of neural mechanisms, the problem remains of explaining how a particular neural mechanism can actually generate red. Since the language used to describe brain activity is quite different from that used to describe phenomenology, there is an "explanatory gap" between the neural and phenomenological descriptions.

In my view of the role of neural mechanisms, we bridge this "explanatory gap". I consider experience to be constituted by a mode of engagement, so it is the properties of the mode of engagement which we have to bring into correspondence with phenomenology to explain the nature of experience. Compared to neural activity, the language used to describe modes of engagement is more similar to that of phenomenology, so we have a better chance of making a connection.

In addition to bridging the "explanatory gap", my approach has the advantage of providing interesting predictions and new ways of looking at known phenomena. I am particularly happy with our approach to the redness of red, which although only a very first step, is surprisingly successful (Philipona and O'Regan 2006). Other examples where the sensorimotor approach provides a new viewpoint are sensory substitution (with a number of devices reviewed in my book), the ability to easily feel the curb against the wheels when you park your car, the rubber hand illusion (Botvinick and Cohen 1998) and the ability of ferrets to see with their auditory cortex (e.g. Sharma et al. (2000)) – all these are no longer seen as cases of "cortical plasticity", but as obvious consequences of the fact that experience is determined by sensorimotor laws. Of course there will ultimately be cortical changes that accompany these phenomena, but they are the consequence, not the cause, of the fact that the brain has come to grasp the accompanying laws.

6 Reply by Ned Block

I have issued a challenge twice, and twice Kevin O'Regan has failed to answer it. The challenge is: name a single sensorimotor law common to the experiences of red in perception, imagery and dreaming. Instead of suggesting even a single sensorimotor anything, he says what is in common is a disjunctive property: instantiating some sensorimotor law in the case of perception OR in the case of imagery and dreaming where the laws do not apply, instantiating the brain state which mediates the perceptual laws. A disjunctive answer concedes that the sensorimotor account does not work. If what is in common is law OR brain state, then nothing that can be the scientific basis of the common experience has been specified.

An analogy: what is in common to all instances of water that makes them water? The "superficial" answer is: they come out of taps, fall from the sky, sustains life, is colorless, etc. But it is possible for there to be water in an alternative universe with no taps, skies and different forms of life, and it is possible for some other substance that is not water (Putnam's (1975) XYZ) to have these superficial properties without being water. The superficialist could give a disjunctive answer: what is common to water in all cases is: it either comes out of taps (etc) OR in the cases where it doesn't, it instantiates the physical state which is responsible for the superficial behavior. But this disjunctive answer in effect concedes that *nothing superficial* is in common. What is really in common is something deep, H_2O.

For both red and water, the superficialist tries to explain what is in common by appeal to a disjunction: the superficial property in the paradigm cases and in the non-paradigm cases, the deep property that underlies the paradigm superficial property.

O'Regan claims that the sensorimotor approach has a better chance of closing the explanatory gap. I don't want to contribute to a diversion, but an input–output

syndrome gets us no closer to an explanation of the experience of red than a brain state—especially given that some experiences of red (imagery and dreaming) don't even satisfy the input–output syndrome. I think the only intellectually honest approach to the explanatory gap is to admit that we do not have the concepts at present that would allow us to close it. To use Nagel's (1974) analogy, we are like pre-Socratic philosophers who are told that matter is energy but do not have the concepts necessary to understand that claim. If you had to bet where such new concepts might be found, would you pick neuroscience or "sensorimotor science"?

The only thing that is genuinely in common to the experience of red in perception, imagery and dreaming, is the brain state—not anything sensorimotor. Sensorimotor theorists have been able to avoid facing up to this failure only because they have not been pressed in so wonderful a format such as the one allowed by this journal. So, I repeat my challenge: name one sensorimotor law that is in common to the experience of red in the myriad cases in which it can appear.

7 Reply by Kevin O'Regan

First, Ned Block is mistaken in saying that my reply to his challenge is a "disjunction". I continue to maintain that *both* in the case of dreaming and imagery, and also in the case of perception, what constitutes the quality of the experience is the sensorimotor law that the experiencer has implicitly grasped or is tuned to. In the case of perception, he really is engaged with the present environment and so is tuned to a particular law. In the case of imagery and dreaming, there is no way of telling that he is not so engaged, since his brain is in the same state as when he is tuned to that sensorimotor law. In both cases, the phenomenal 'feel' is characterized by the sensorimotor dependencies that the brain has registered as applying, whether or not they actually do apply. For example, if it is possible to so vividly imagine the softness of a sponge that your brain is tuned to the sensorimotor dependencies of sponge–squishing, then you will be experiencing the softness (of course this can only happen when the relevant laws have been previously learned).

Second, Ned Block's analogy with water is inappropriate. The argument would be justified if experience were a thing. But experience is, under the sensorimotor approach, not a thing. It is a potential, or capacity, that an agent possesses. There are many instances of such functional or abstract concepts in science: force, pressure, predator, etc. Let me counter Ned Block's water analogy with the analogy of *life,* and ask his same question: what is in common to all instances of life that makes them alive? Now what he calls the "superficialist" answer is the correct one, since we can imagine life forms that are not instantiated in the same materials as ours.

In the case of sensory experience, the "deep" thing that characterizes its quality is nothing neural: it's what we do when we have it. What we *mean* by experiencing softness is being able to squish the sponge by pressing on it.

While this is obvious for softness, I admit it is harder to imagine for redness. Nevertheless, the sensorimotor approach takes this tack even for redness and other sensations. As examples of the scientific advantage of doing this: though I am still far from characterizing redness completely, my work on color makes a promising start; with the sensorimotor concepts of bodiliness, grabbiness and insubordinateness I can

explain why sensations like red have the mysterious "something it's like" or sensory presence or "realness" that they have.

I suggest that the error that Ned Block is making about experience is the error of reification. It is analogous to the error that vitalists at the beginning of the 20th century made, searching for a vital spirit. Today it is scientifically advantageous to stop reifying experience.

Third, as regards the explanatory gap: the language that we use to describe sensorimotor laws is easier to put into correspondence with the quality of experience than is the language of neural activation. For example, I don't think Ned Block can deny that we are closer to understanding what softness is like when we say that it involves being able to squish something, than when we say that it involves such and such neural activation. I admit that in the case of redness it is harder to make the link, but, as said above, progress is being made.

8 Reply by Ned Block

"The" sensorimotor theory seems to be an ever-morphing thing. In the last post, Kevin O'Regan endorses a uniform (non-disjunctive) theory of the experience of red in perception, imagery and dreaming as a "sensorimotor law that the experiencer has implicitly grasped or is tuned to." However, there are two very different views that fit this description. The experience of red is:

1. Some kind of cognitive appreciation of or expectation concerning the instantiation of a sensorimotor law (what I called COGNIZING in an earlier post).
2. A capacity or disposition to an activity that instantiates a sensorimotor law.

I mentioned both in my first posting (and in addition, an "activity" view that O'Regan now seems to have abandoned).

In having a cognitive appreciation of a law involving inputs and outputs, one has to think of or represent those inputs and outputs in some WAY. A machine or a creature from outer space might be able to think of human inputs and outputs in WAYS that do not involve any conscious experience. Alternatively, the WAY might itself be phenomenal—say if our cognitive appreciation is coded in imagery. Given that cognition cannot grasp anything without grasping it in some WAY, the appeal to COGNIZING in explaining sensory qualities smuggles in the very notion that is supposed to be explained. (See Block (2005). This point also came out in David Chalmers' and Alvin Goldman's contributions to the discussion of O'Regan's paper at NYU in Fall, 2010.) A further point is that COGNIZING is supposed to be O'Regan's account of what it is for a sensory quality to be conscious, so he can hardly use it as a theory of sensory quality itself.

Moving to the capacity variant, note that right now, I have the capacity to squeeze a sponge or stop at a red light even though I am not *now* experiencing anything soft or red. To get to first base, an account of conscious experience of the capacity-sort has to appeal to some kind of a *temporary* disposition or tendency that I have *now*. But what would those temporary dispositions common to experiencing red in perception, imagery and dreaming be? Here we come up against the fact that the sensorimotor view and its ancestor, behaviorism, has never specified any such tendencies. *So I will*

re-issue my challenge, adapted to the ever morphing sensorimotor view: name one temporary tendency that is common to experiences of red (and not green) in perception, imagery and dreaming. And note that it is no good to speak vaguely of one's brain being tuned to something since there is no reason to think that one's brain is tuned to the relevant features of the outside world when one is experiencing red in dreaming or imagery. O'Regan says that in dreaming or imaging red, one's "brain is in the same state as when he is tuned to that sensorimotor law" in perception. But that is known to be false. Activations in early vision are known to be different in imagery and dreaming from perception. What is the same is activations in areas that *underlie conscious experience*. But O'Regan can hardly appeal to that fact.

One further point relevant to the charge of reifying. One way the sensorimotor theorist can respond to the fact that he can't find anything sensorimotor that can explain what is common to experiencing red in perception, imagery and dreaming is to deny that there is anything substantive in common. If reifying conscious experience is just holding that there is something substantive in common to the various kinds of experiencing red—something that we want a scientific account of–then I am happy to be a reifier.

9 Reply by Kevin O'Regan

Ned Block thinks the sensorimotor theory is "ever morphing". With due respect, I say that what is ever morphing are his successive misinterpretations of the theory!

Take Ned Block's interpretation 1 of the sensorimotor theory, above. He says "The experience of red is: some kind of cognitive appreciation or expectation concerning the instantiation of a sensorimotor law".

No! To repeat what I have already said at the very beginning: The experience of red becomes *conscious* when there is a certain kind of cognitive access to the fact that the brain is tuned to the sensorimotor dependencies of red. Cognizing in the theory determines whether the person is conscious of an experience, and of what aspects he is conscious. This may include cognizance of the fact that a real-world interaction is actually occurring, that it is a visual one, that it involves red and not green (perhaps these are Ned Block's WAYs of access?). There is no problem of "smuggling in" what I'm trying to explain.

Ned Block's martian could cognize about inputs and outputs that describe the sensorimotor laws of red for humans, but his brain could not be tuned to the laws, since his sensory and motor apparatus do not support human type laws. If through sensory substitution with martian sense/motor organs it were possible to approach human laws in martians, the martian might start having similar experiences to humans.

Now take Ned Block's interpretation 2: The experience of red is: "A capacity or disposition to an activity that instantiates a sensorimotor law."

No! Activity does play a role in the determining the quality of an experience, but this is indirectly, through its role in defining sensorimotor dependencies. When the brain recognizes (correctly or incorrectly) that currently an interaction is going on with the environment that corresponds to a particular sensorimotor law that has been previously categorized, then this defines the quality of the experience that is occurring. Thus one should not think of the theory as directly involving either actual

activity, or disposition to activity, be it what Ned Block calls "temporary" or not. There are links to these notions, but the links are somewhat subtle.

Ned Block says his "activity" alternative suffers from the criticism that it cannot account for dreams and imaging. But since the sensorimotor theory is not an activity theory, Ned Block's criticism "falls flat", to use a term he uses.

I need not detail yet again how the sensorimotor theory accounts for dreaming and imagery. Let me just recall that in the case of dreaming and strong visual imagery, *both* Ned Block and I can appeal to the idea that there may be brain states that are activated which are (partially) common to those that occur in veridical perception. But in my case these brain states are not themselves the *cause* of the similarity in phenomenality. The cause of the similarity in phenomenality is in the sensorimotor dependencies that the brain states are tuned to.

I think it is time to step back from this debate and take the toll. Something is preventing us from achieving any kind of mutual understanding.

The problem is in a deeply different view of what we are looking for in an explanation of consciousness. Ned Block wants to find the answer in the brain. My tactic of de-reifying experience says there will certainly be brain mechanisms that are involved in consciousness, but they themselves are not generating the consciousness. They are enabling the mode of interaction with the world that determines the quality of our phenomenal experiences. And they are providing a higher form of cognitive access to these qualities.

10 Reply by Ned Block

Kevin O'Regan has told us what is NOT in common to the experiences of red in perception, dreams and imagery. First, it is not any kind of expectation or representation or other form of cognizing. Second, it is not any kind of disposition to an activity nor a capacity to engage in an activity that instantiates a sensorimotor law. As to the positive account, he speaks of the brain being "tuned" to a sensorimotor law and the brain "recognizing" (and in earlier posts "registering") an instantiation of a sensorimotor law. Of course recognition is a species of cognition so it cannot be taken literally—nor can "tuning" or "registering". So what we have by way of a positive account is really just a metaphor.

Still, whatever exactly it is to be tuned to a sensorimotor law, we can see that any such view will have trouble with imagery and dreams. O'Regan's chapter on the phenomenology of color perception emphasizes the way we manipulate something to see its color accurately, "the changing responses of our photoreceptors as we move surfaces around under changing illumination." (128) Of course photoreceptors need not be stimulated in imagery and dreams, but the real point is deeper: Here is an exercise: Form an image of the letter between 'C' and 'E' in the alphabet in upper case. Rotate it counter-clockwise 90° and place it on top of an upright form of the letter between 'L' and 'K'. What do you see? (Answer below.) Did your image specify anything to do with the source of illumination or what would happen if you move your head? In my case at least, the images seem too abstract for those questions to apply.

Even basic perceptual experience does not need to involve sensorimotor relations–as born out by neuroscience. The minimal neural basis of perception does not include

much of the classic peripheral sensorimotor areas. The basic phenomenology of vision can survive vast destruction in motor areas and early sensory areas on both sides of the brain (Pollen 2008; Pollen 2011). For example patients who have lost V1 can nonetheless have "intense visual…hallucinations" (Stoerig 1996, 2001). On the motor side, there is no evidence that what Pollen calls "primary visual perception", perception of color, shape, texture, motion and the like, is destroyed by loss of frontal or prefrontal cortex, including classic motor areas (although parietal reach planning areas might be essential).

I have repeatedly challenged O'Regan to say what is in common to the experience of red in perception, imagery and dreams (and I might add hallucination) and he has repeatedly ignored the challenge. But how could an approach that emphasizes manipulation of objects and stimulation of photoreceptors possibly answer? And the point is not specific to color. The same point applies to the experience of the formation of an umbrella by putting together the 'D' and the 'J' described earlier. The manipulation is motor in one case but purely inside the head in the others, so what is in common is manifestly not anything motor.

Now I do not say that we have now or are likely to get soon an *explanation* of experience in neural terms, but as Nagel (1974) pointed out, we can have evidence for a physicalist thesis without yet having developed the concepts that would be needed for an explanatory understanding of it.

11 Reply by Kevin O'Regan

This debate has involved a somewhat unconstructive battery of attacks. In his latest post, Ned Block now accuses the theory of being founded only in metaphors. The notion of the brain being "tuned" to a sensorimotor law is opaque to him. Whatever it means, he thinks, the theory will not be able to account for imagery and dreams.

To help, let me recall the analogy of the softness of a sponge, due to E. Myin (e.g. (2003)). This is really an excellent analogy because even opponents to the sensorimotor theory will probably accept it, the problem being merely to take the strenuous step of applying it to all feels. The sponge analogy is also excellent because it illustrates several important points about the nature of the sensorimotor theory. First, it shows that the sensorimotor account is in some sense providing not an explanation, but a definition of feel. It also shows that under this definition, the role of the brain is not to generate feel, but to enable the interaction to which we give the name "feel". Finally, it defines the role of conscious access in phenomenality as determining whether one is conscious of something, and of what aspects one is conscious. The experience itself however, resides in the occurrence of the actual interaction with the sponge (but see below for cases of non-veridical experiences).

So let me try to describe in more detail what is really going on when I feel the softness of the sponge.

> Case 1: veridical perception: I am really squishing the sponge.
> (a) My brain activates my muscles, my fingers press, sensory changes are produced in tactile input. My brain detects (I have previously used the words "notes", "recognizes" and "registers", but perhaps these were misleading: I do

not want there to be any notion of representation or cognition in this) the currently applicable input–output relationship, which is similar to one that it has previously encountered, namely the one I have previously cognitively classified as corresponding to the category "softness". There are also other aspects of the ongoing interaction which my brain detects, e.g. that the interaction is what I have cognitively classified as "tactile", rather than visual, say; and, importantly, that the interaction has the properties of real interactions with the world, namely bodiliness, grabbiness and insubordinateness. There are yet other properties of the current interaction which my brain has never previously encountered, but my brain can nevertheless detect the fact that "stuff is going on", and I can cognitively categorize this fact. NOTE: this situation is what I call "the brain being tuned" to the sensorimotor laws of softness. NOTE ALSO: the brain can detect that an input–output law is applicable even when there is currently no input and no output. For example, at this moment I may be poised at the extreme end of my squishing motion where there is no movement and virtually no pressure on my fingers, and yet my brain is currently tuned to the law of sponge squishing.

(b) I as a person have cognitive access to the categories that the brain has detected to be occurring. I know thus that I am currently feeling softness, that it is a tactile sensation, that it is "real" because it has the property of "presence" that is provided by bodiliness, grabbiness etc, and that it is an ongoing interaction.

The above situation is what is meant by me experiencing the softness. It is a matter of definition, not a matter of fact. Thus the "feel" is not being generated in any way, let alone in the brain. The brain is contributing to the feel occurring, but not by generating the feel. It is contributing by enabling the situation which by definition corresponds to the feel occurring.

Note also that in this definition, the experiencing itself lies in the actual doing of the squishing. The quality of the experience is an abstraction that can be cognitively categorized as being that of softness, and of being tactile, real or "present", among other things. My cognitive access gives me access to a classification of the experience, but the phenomenality itself resides in the actual doing. Thus the cognitive access is not smuggling in the phenomenality. This answers Ned Block's problem with what he calls the WAY of cognizing.

Ned Block's other problem concerns how the account deals with imagery and dreaming. for this, consider:

Case 2: non-veridical perception.
Given the definition of veridical perception above, there are two (non-exclusive) ways in which I could have the feel of softness of the sponge without me actually squishing the sponge. One depends on tricking mechanism (a), and one on tricking mechanism (b).

Tricking mechanism (a) could occur by someone doing brain stimulation on me, or brain activation occurring endogenously, that somehow creates similar brain states to those that occur when I am actually engaged in squishing the sponge, and when the brain detects that the laws that currently apply are those of softness, tactile stimulation, bodiliness, grabbiness etc., and "stuff going on". This might be what happens in hallucinations, some dreaming, and strong

imagery. The tricking of mechanism (a) could be more or less complete, and this would give rise to different strengths of imagery. For example in cases where the states corresponding to the laws of grabbiness etc. are not activated, I would know that this is not a real-world experience, even though it is very similar.

Tricking mechanism (b) could occur by me incorrectly having cognitive access to the things that my brain is "tuned" to. This could occur in dreaming, when my epistemic standards are lowered, and perhaps also in some forms of imagery. This situation would be compatible with observations of imagery occurring without brain areas being involved that are usually activated in perception or action.

There can of course be cases involving tricking of both mechanisms (a) and (b), and the tricking may be more or less complete, explaining why different brain areas may be involved.

I hope that this clarifies my answer to Ned Block's second concern, namely of how the the sensorimotor approach can account for imagery and dreaming.

12 Response by Ned Block

I found this last response helpful in understanding O'Regan's theory. He proposes to explain what is in common to the experiences (say of red) in imagery, dreaming and hallucination and perception by appealing to a common brain state—veridical in one case and "tricked" in the others. This is a response I endorse (though I don't think of imagery and dreaming as involving any kind of trickery). But note the consequence: a "tricked" brain in a vat with exactly the brain activation that I now have would have the same experiences that I am having now despite lacking a body. Some sensorimotor theorists (Noë 2004) have tried to avoid this consequence by saying that the computer that feeds inputs to the brain would *in effect be the body*. However as I have noted (Block 2005), this response does not work because exactly the same history of brain stimulation that is hypothetically produced by the computer attached to the brain in the vat *can occur by chance*. This is unlikely but not impossible. And in this unlikely but not impossible case, O'Regan would have to say—as I understand him—that the brain in a vat and the perceiver whose brain is in the same state would have the same experience. The brain would be "tricked without a tricker".

But who cares about such vanishingly unlikely possibilities like the brain in a vat whose activations are produced by chance? We want to explain normal experiences. Yes, but these unlikely scenarios provide a litmus for what a theory really is fundamentally committed to. And what O'Regan is fundamentally committed to—if my understanding is correct–is that the minimal physical basis of the experience of red in imagery, dreaming, brain stimulation and perception is a state of the brain, not the body. No body is even necessary. Indeed the brain in the vat *need never have been attached to any body.*

If that is indeed his view, then I note that he differs from many others who are classified as sensorimotor theorists such as Susan Hurley, Alva Noë and Evan Thomson, thinkers who have firmly rejected the idea that there is a minimal physical basis of conscious experience to be found in the brain (Thompson and Varela 2001; Noë 2004; Hurley 2010). This is why I described his view in an earlier posting as a capitulation.

If the physical basis of the experience of red in all its cases is a brain state, then why is O'Regan a sensorimotor theorist at all? The answer I believe (but he can correct me) is that what *makes* that brain state the experience of red is that it in some way encodes, registers, recognizes or is tuned to a (alleged) sensorimotor law. As I understand it, this is a theory of the "explanatory gap", the name given to the fact that we have no idea why the scientific basis of a given conscious experience is the basis of that experience rather than another or none. But if that is the rationale of the theory, he owes us an account of how registration of sensorimotor laws is supposed to close or even narrow the gap. Is it any less of a mystery of why a certain behavioral syndrome—or tuning to it–is associated with a certain quale than why a certain brain state is associated with that quale?

O'Regan gives the example of the experienced feeling of softness as revealed in the sensorimotor activity of squishing. The word 'soft' is defined in dictionary.com (definition 1) as "Yielding readily to touch or pressure; easily penetrated, divided or changed in shape". And 'feeling' in 'feeling an object' can be construed as an activity involving manipulation. To the extent that the softness of an object is literally to be defined in terms of an activity of manipulating the object, and 'feeling' is postulated to be an activity, then it is not an interesting fact that the experience of feeling softness in perception, dreaming and imagery involves an activity, real or represented. The 'feeling' in feeling hot or feeling pain is quite different and does not require any activity, real or represented. It is to avoid the misleading impression that imagining must be *imagining doing* that I chose the example of experiencing red—a property which has no "standard" associated activity, except maybe stopping at a red light. This is why the reader will search this whole exchange in vain for the slightest hint from O'Regan of even a speculative hypothetical candidate for a sensorimotor law whose encoding or registration is in common to the experience of red in perception, imagery, dreaming and hallucination. The candidate sensorimotor laws discussed in O'Regan's chapter on color all involve light and movement. And as I argued earlier, these items need not be involved or registered in imagery or dreaming.

The reader may think: OK, some examples (soft) support the sensorimotor view and others (color) support other views, so both sides will have to struggle to get all the examples to support their view. Wrong! The "phenomenist" view I advocate allows that the experience of the activity of feeling something soft involves representing an activity even in dreams and images. This triviality supports neither view. Thus the cases that are supposed to support O'Regan's view equally support mine, but his view can't handle the cases that support mine.

13 Response by Kevin O'Regan

Ned Block is beginning to understand my approach. As concerns the brain in the vat or the brain accidentally in exactly the same state as a person experiencing red, yes, I agree that the person instantiated by that brain would be experiencing red. (Providing the vat provides the brain with the perfect illusion of a real physical environment, and that the brain has completely encoded the person's past history, in particular of seeing red things).

And Ned Block is *almost right* when he says that in my view "what *makes* that brain state the experience of red is that it in some way encodes, registers, recognizes

or is tuned to a sensorimotor law". Only *almost right* because it is not the brain state that itself "*is"* the experience of red. The brain state would usually *enable* the interaction with the world, and it is this interaction which "*is"* the experiencing of red.

Note that I used the word "usually" in the last sentence. This is to allow for pathological cases like the brain in the vat, accidental brain states, hallucinations, dreaming and imaging, where, to different degrees and in different ways, a person assimilates the current situation to one where they really are interacting with the world.

And yes, taking this stance spans the explanatory gap. As Ned Block agrees, the approach works pretty well for softness. The trick is to make it work for all sensory experiences. A priori I agree with Ned Block that many such experiences, in particular color experiences, *seem* quite different from softness because they *seem* to involve no action. My bet is that it is nevertheless possible to take the sensorimotor approach even in these cases. Indeed, as mentioned several times here, I have very successfully made inroads for understanding color in this way.

I have also made inroads in understanding the philosopher's most mysterious notion of "what it's like" or "sensory presence" of experiences. I have done this by using the objective notions of bodiliness, grabbiness and insubordinateness which help in defining what we mean by this expression. Taking this view led me to the prediction of change blindness.

So not only can we bridge the explanatory gap, we can be led to interesting science, with sensory substitution and phenomena like the rubber hand illusion as other examples.

And why, asks Ned Block, "is it any less of a mystery why a certain behavioral syndrome [I would prefer to say 'mode of interaction'] is associated with a certain quale than why a certain brain state is associated with that quale?" As I've explained in earlier replies, and as the case of softness eloquently (and indeed, I agree with Ned Block, trivially!) shows, the answer is that the language used to describe modes of interaction is naturally related to the language of experience. Here, contrary to the situation in Block's "phenomenist" approach, no arbitrary "linking" hypotheses (cf. Teller 1984) need to be made to link brain states to experience.

Acknowledgments Kevin O'Regan wishes to thank Jan Degenaar, Erik Myin and Oliver Kauffmann for extensive help in his responses.

References

Block, N. 2005. Review of Alva Noë, *Action in Perception*. *The Journal of Philosophy* CII(5): 259–272.

Block, N. 2009. *Comparing the major theories of consciousness. The Cognitive Neurosciences IV. M. S. Gazzaniga*, 1111–1122. Cambridge: MIT.

Boring, E.G. 1940. Size constancy and Emmert's Law. *American Journal of Psychology* 53(2): 293–295.

Botvinick, M., and J. Cohen. 1998. Rubber hands "feel" touch that eyes see. *Nature* 391: 6669.

Brockmole, J.R., R.F. Wang, et al. 2002. Temporal integration between visual images and visual percepts. *Journal of Experimental Psychology: Human Perception and Performance* 28(2): 315–334.

de Gardelle, V., L. Charles, et al. 2011. Perceptual awareness and categorical representation of faces: Evidence from masked priming. *Consciousness and Cognition* 20: 1272–1281.

Debner, J.A., and L.L. Jacoby. 1994. Unconscious perception: Attention, awareness and control. *Journal of Experimental Psychology: Learning, Memory and Cognition* 20: 304–317.

Goodale, M.A., and K. Murphy. 1997. *Action and perception in the visual periphery. Parietal lobe contributions to orientation in 3-D Space. P. Their and H.-O. Karnath*, 447–461. New York: Springer.
Hurley, S. 2010. *Varieties of externalism. The extended mind. R. Menary*, 101–154. Aldershot: MIT.
Kosslyn, S.M., W.L. Thompson, et al. 2006. *The case for mental imagery*. New York: Oxford University Press.
Lamme, V. 2004. Separate neural definitions of visual consciousness and visual attention: A case for phenomenal awareness. *Neural Networks* 17: 861–872.
Lewis, K.J.S., G. Borst, et al. 2010. Integrating visual images and visual percepts: New evidence for depictive representations. *Psychological Research* 75(4): 259–271.
Myin, E. 2003. Ac account of color without a subject? Commentary on Byrne and Hilbert. *Behavioral and Brain Sciences* 26(1): 42–43.
Nagel, T. 1974. What is it like to be a bat? *The Philosophical Review* LXXXIII(4): 435–450.
Noë, A. 2004. *Action in perception*. Cambridge: MIT.
O'Regan, J.K. 1992. Solving the "real" mysteries of visual perception: The world as an outside memory. *Canadian Journal of Psychology* 46(3): 461–488.
O'Regan, J.K. 2011. *Why red doesn't sound like a bell: Understanding the feel of consciousness*. Oxford: Oxford University Press.
O'Regan, J.K., and A. Noe. 2001. A sensorimotor approach to vision and visual consciousness. *Behavioral and Brain Sciences* 24: 883–975.
Philipona, D., and J.K. O'Regan. 2006. Color naming, unique hues and hue cancellation predicted from singularities in reflection properties. *Visual Neuroscience* 23(3–4): 331–339.
Pollen, D.A. 2008. "The Fundamental Requirements for Primary Visual Perception." *Cerebral Cortex* 18.
Pollen, D.A. 2011. On the emergence of primary visual perception. *Cerebral Cortex* 21(9): 1941–1953.
Putnam, H. 1975. The meaning of 'meaning'. *Minnesota Studies in the Philosophy of Science* 7: 131–193.
Sharma, J., A. Angelucci, et al. 2000. Induction of visual orientation modules in auditory cortex. *Nature* 404: 841–847.
Stoerig, P. 1996. Varieties of vision. *Trends in Neurosciences* 19: 401–406.
Stoerig, P. 2001. The Neuroanatomy of Phenomenal Vision: A Psychological Perspective. Cajal and Consciousness: Scientific Approaches to Consciousness on the Centennial of Ramon y Cajal's Textura. P. C. Marijuan. *Annals of the New York Academy of Sciences* 929: 176–194.
Teller, D.Y. 1984. Linking propositions. *Vision Research* 24: 1233–1246.
Thomas, N. 1999. Are theories of imagery theories of imagination? *Cognitive Science* 23(2): 207–245.
Thompson, E., and F. Varela. 2001. Radical embodiment: Neural dynamics and consciousness. *Trends in Cognitive Sciences* 5(10): 418–425.