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Perceptual Consciousness, Access to Modality and Skill Theories

A Way to Naturalize Phenomenology?

We address the thesis recently proposed by Andy Clark, that skill-mediated access to modality implies phenomenal feel. We agree that a skill theory of perception does indeed offer the possibility of a satisfactory account of the feel of perception, but we claim that this is not only through explanation of access to modality but also because skill actually provides access to perceptual property in general. We illustrate and substantiate our claims by reference to the recently proposed 'sensorimotor contingency' theory of visual awareness. We discuss why this theory offers a distinctively attractive access-based approach to perceptual consciousness because it 'dereifies' experience and permits otherwise problematic aspects of phenomenal perceptual consciousness to be explained. We suggest our approach thus offers the prospect of 'naturalizing phenomenology'.

I: Introduction

The qualitative or phenomenal aspect of consciousness, the fact that it feels like something to be conscious, stands central in consciousness studies. The issue turns up in many guises. At the most fundamental level, there is the problem of why phenomenality exists at all: couldn't there be creatures that were behaviourally or functionally identical to phenomenally conscious creatures but without phenomenal consciousness?

In a much discussed paper, Ned Block has approached this question by introducing a difference between 'access consciousness' and 'phenomenal consciousness' (Block, 1995). Access consciousness refers precisely to functional/behavioural aspects of consciousness. Roughly, a mental phenomenon is access conscious if it 'is poised for global control of action'. One way of filling out this formula is by thinking of the mind/brain as a computational device, in which

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various pieces of information or representation are 'processed' in order to generate either further mental representations (that can enter new cycles of processing) or behaviour (this is clearly Block's view; see Block, 2001, p. 202). A prevalent view of consciousness within such a view is that those representations that become dominant, in the sense that they attract most processing capacities available, and are directly determinative of a creature's ensuing behaviour, also become conscious. Block's (1995) paper was aimed at reminding theorists that there might be a conceptual difference between the kind of 'access consciousness' captured by such theories and full-blown qualitative consciousness, which they would not necessarily capture. Block claimed that though in all real cases phenomenal consciousness and access consciousness almost always co-occur, there remains a conceptual difference between the two.

The issue of qualitative consciousness doesn't turn exclusively on why it exists at all. Recent theorising has also focussed on important questions concerning similarities and differences between qualities (Clark, 1993). At one level, such issues concern relations between similar qualities, such as the various hues. In short: how to explain phenomenal facts such as that red seems more similar to purple than to green? At a prima facie different level, other questions pertain to similarities and differences between modalities. Why, for example, is seeing different from hearing? Why has a visual sensation a different 'feel' than an auditory sensation?

Recently, Andy Clark (2000a,b) has presented an intriguing argument that is of great relevance for a number of these questions regarding phenomenal feel. The thesis he defends is that 'unmediated or non-inferential access to modality' necessarily implies the presence, in perceptual consciousness, of phenomenal feel. Clark suggests that if a perceiver has unmediated, non-inferential access to the act of detection of perceptual properties, she necessarily is conscious.

In his own example, if a colour perceiver not only is able to detect differences between colours but is also able to detect whether the detection is visual, versus, for example, auditory, and if this ability comes about because of direct, unmediated or non-inferential access, the perceiver must be having phenomenal experience. The reason why Clark holds this thesis is that 'the fact that she has direct unmediated access to certain distinctive physical or functional features of the visual encoding' will 'force upon the agent' 'the idea that there is a special sensational quality present'. (Clark, 2000b, p. 23). In other words, non-inferential access not only to what is perceptually detected, but also to aspects of the process or act of detection itself will imply that, to the creature, it will 'feel like something' to perceive. Clark writes:

> To be access-aware of the act of detecting a difference requires at least saying(honestly) that the two items seem different in some modality-specific respect. So in this case, access-awareness (of the act of detecting a difference using a specific modality) seems to imply that there is (or is reported to be) something it is like to detect the difference. (Clark, 2000a, pp. 30–31)

As said, the notion of access at play is the one brought to prominence by Ned Block's distinction between access consciousness and phenomenal consciousness (Block, 1995; 2001) and Block's arguments that this notion of access consciousness is at least *conceptually* distinct from the notion of phenomenal consciousness. Clark's argument is meant to undermine this claim of conceptual difference at least in the case where a creature has access to modality: in that case, Clark holds, access consciousness *is the very same concept* as phenomenal consciousness.

Elaborating his thesis, Clark proposes that an account of how a creature could have proper access to modality can be given by a 'skill theory' of perception.[1] According to a skill theory, as Clark uses the term, referring to Evans (1985) and Grush (1996), perceptual content is constituted by the behavioural skills available to the perceiver by virtue of perception. An experience has a specific spatial content, for example, to the extent that it allows the perceiver to make appropriate movements with regard to space: to orient, to reach or to grasp (Clark, 2000a, p. 34). As different modalities clearly endow perceivers non-inferentially with different 'batteries' of abilities, access to this set of skills provides a natural way to account for access to modality. A perceiver could then, by directly noticing that it was exercising its 'visual' rather than 'auditory' battery of skills, know that it was seeing rather than hearing.

Clark emphasises that for a skill theory, the enabled actions need not be actually deployed. Perceptual content is constituted by the *potential* for action enabled by the experience.

II: Clark's Thesis in Perspective

We think Clark has offered an extremely interesting set of ideas. That is to say, we think Clark's arguments and suggestions together offer the right components for an account of phenomenality, but we think Clark has not assembled all the pieces in the right way. In particular, we find unconvincing the contrast suggested by Clark's argument between access to modality and access to sensory quality. For example, we do *not* agree that intuitions that artefacts cannot be conscious are less convincing in the case in which the artefacts have access to modality, over and above access to sensory quality: it seems to us that a robot that would be able to discriminate whether an input was visual and not tactile would not *thereby* become a better candidate for being called conscious than a robot that would be able to discriminate whether an input was red versus green. Thus, we disagree with the general thesis that access to modality would imply phenomenal consciousness. Similarly, we don't see why someone who believes neurocomputational mechanisms can never account for phenomenal consciousness would have to change their opinion in the case where the neurocomputational mechanisms mediate access to modality, rather than access to sensory modality.

However, we do think that the whole picture changes when, as Clark (cf. also Evans (1985), Grush (1998), to which Clark refers) invites us to do, things are seen from the perspective of what Clark calls a 'skill theory'. We think the

[1] He also mentions a different possibility, in which access comes from sensitivity to the specific form of the vehicles that carry modality-specific content (Clark, 2000a,b) We won't address that possibility here, but refer the reader to O'Regan and Noë (in press a) for arguments against this option.

framework of a skill theory allows construction of an explanatory theory of the phenomenality of perception to which none of the objections against accounts of phenomenal consciousness in terms of neurocomputational mechanisms apply.

Before looking at a particular skill theory, let us consider first what exactly a theory of perceptual phenomenology is supposed to deal with.

III: What Experience is Like

The whole discussion concerning phenomenal and access consciousness turns around 'what it is like to perceive'. For example, what Clark claims in the quotation given above is that a creature that has access to perceptual modality would thereby be a creature for which it is something like to perceive. But what *is* it like to perceive? Or, focussing on visual experience, what is it like to *see*?

Traditional analyses concur on a number of properties, of which we think the following list is fairly representative.[2] First, seeing comes with particular sensory qualities, such as 'redness' or 'brightness'. Second, seeing comes with a specific visual character, a mark of 'visuality', that is distinctly different from the 'character' of experiences in other modalities. Third, visual experience possesses a number of properties that are essential characteristics of experience in general. Notable items here are *ongoingness, forcible presence, ineffability and subjectivity*. *Ongoingness* means that an experience is experienced as occurring to me, or happening to me here, now, as though I was inhabited by some ongoing process like the humming of a motor. *Forcible presence* is the fact that, contrary to other mental states like my knowledge of history, for example, a sensory experience imposes itself upon me from the outside, and is present to me without my making any mental effort, and indeed is mostly out of my voluntary control. *Ineffability* indicates that there is always more to the experience than what can be described in words. Finally, *subjectivity* indicates that the experience is, in an unalienable way, *my* experience. It is yours or mine, or his or hers, and cannot be had without someone having it. But subjectivity also indicates that the experience is something *for me*, something that offers me an opportunity to act or think with respect to whatever is experienced.

We do not claim that this list is exhaustive. But, however incomplete it may be, it does allow us to emphasise what we think is an extremely important, but often neglected, feature of phenomenal awareness, namely that 'phenomenality' is a complex property. Instead of being a 'simple' property, that, if 'attached' to otherwise non-phenomenal somethings, render these 'phenomenal', it has many aspects, each of which might require a particular explanation.[3]

[2] Most of these features figure prominently, though not tracably to specific locations, in Merleau-Ponty (1945/1976).

[3] This implies, as acknowledged by Clark, that if his thesis is true, access to modality might only explain a partial aspect of full-blown phenomenality (2000a, pp. 36–7).

IV: The *Problem* of Phenomenality

Phenomenal consciousness is generally considered to offer resistance to attempts at explanation in terms of what allegedly ought to explain it; namely neuroscience. The crux of the problem is that nothing in the brain would appear to be able to engender the properties that characterise phenomenality. This problem occurs both if one considers the brain as a physiological mechanism, or if one takes the view of the brain as an information-processing device. In particular, as regards:

- *Ongoingness*: the ongoing character of experience would naturally suggest that experience is generated by an accompanying ongoing internal process in the brain, like, say, reverberation in cortical circuits, or synchronously firing neuron pools. But what physico-chemical process, no matter how complex, can be more than . . . a physico-chemical process? How can motions of ions or electrons or firings of neurons provide an *experience*?

- *Sensory quality*: even if the problem of ongoingness were solved, it is unclear how one particular neurophysiological or computational process could give rise to a sensation with one particular sensory quality, and another process could give rise to another quality. Since neural activity presumably corresponds to manipulation of internal codes that correspond to outside events, one can always ask: 'What determines the particular mapping from a code or process in the brain to a particular sensation? Why does this particular code or process correspond to this particular red hue sensation and not to another hue sensation, such as green?'

- *Modality*: it is equally unclear why a particular neurophysiological code or computational process gives rise to a sensation with a modality-specific 'feel' to it. It is always possible, for any particular neurophysiological or computational process that is associated with a visual experience, to ask: 'Why does this particular process give rise to a visual sensation, rather than an auditory one?'

- *Ineffability*: in contrast to experience, which can never be adequately described, a neurophysiological or computational process seems completely and exhaustively describable.

- *Subjectivity*: a neurophysiological or computational process seems to be perfectly objective, completely on a par with the other things studied by natural science, be it subatomic particles or mountains. Since the latter are obviously not subjective, and brain processes are in all relevant respects like them, it becomes a mystery how brain processes could be associated with subjectivity.

The preceding examples suggest that the fact that phenomenality seems unexplainable has its root in a fundamental difference between the mechanisms that might be invoked to explain phenomenality, and phenomenality itself. We take it that this problem also lies at the origin of Block's distinction between phenomenal and access consciousness, for Block seems to think of access consciousness as a 'neurocomputational notion' (see our reference to Block, 2001, in section I).

We also think that this problem is present in a possible interpretation of Clark's argument. If, as suggested by some passages in Clark (for example, 2000a, p. 33), access to modality is identified with some internal process in the brain, then we think the attempt to explain phenomenality through it founders.

In the next section we argue that picking up Clark's suggestion of *access through a skill theory*, however, completely changes the perspective on phenomenality.

V: Skill Theories

The heart of a skill theory, as presented by Clark (cf. again Evans, 1985; Grush, 1998, referred to by Clark) lies in the connection between perceptual content and the potential for action for the perceiver: perceptual content is claimed to be *constituted* by the possibility for action provided to the perceiver by the perceptual situation. Under skill theories we take the stance that sensation is not caused by some internal process in the brain, but rather that it is *constituted* by a set of capacities to act that the organism possesses.

This tight connection between perceptual content and possibility for action is emphasised in several recent approaches to perception (see, besides earlier references to Evans and Grush, Hurley, 1998; Freeman and Núñez, 1999) and has been central to many other theorists' work. It is related, for example, to Heidegger's (1927) notion of 'zuhanden sein' (ready-to-hand), which he presents in his description of a hammer, stressing that we do primarily perceive it as 'a thing we can use in such and such ways'. It is also pivotal in Merleau-Ponty's 'Phenomenology of perception' (Merleau-Ponty, 1945/1976), in which perception is analysed in terms of a subject's ability to deploy its bodily determined capacities to create a 'niche' to act and exist in. Building on Heidegger and Merleau-Ponty, Hubert Dreyfus has further elaborated the idea of perception and cognition as a skill (Dreyfus, 1996). On the psychological side, related ideas have been proposed by J.J. Gibson in his emphasis on the active and exploratory nature of vision, and in the notion that we perceive 'affordances'; that is, 'the possibilities for action which objects of perception provide or afford' (Gibson, 1979).

This skill-related approach to perception is receiving increasing interest. It stands out in at least two respects compared to more traditional and still 'mainstream' cognitive science. First, by emphasising that perception concerns the activity of an organism in an environment, the traditional focus on the 'inner' as the locus of importance is abandoned. This implies — and this is the second respect — that perception is not, as in many traditional approaches, seen as the establishment of inner representations of the outside world, but rather as active engagement with this outer world (see Myin, 2000, for an overview of the differences between the two approaches).[4]

And this is where skill theories provide a path to naturalizing phenomenality. Just as life is not caused by a vital spirit imbued into organisms, but consists in various capacities that organisms have to move, respire, reproduce, etc., from the point of view of skill theories, phenomenality is not caused by some brain process, but is constituted by the different *capacities* that 'feeling' involves. Explaining phenomenality, instead of consisting in finding a neural mechanism that imbues phenomenality into physico-chemical processes within the brain, thus becomes the task of accounting for each of the different capacities that the organism displays when it engages in perceptual activity. And each of these capacities, since it is functionally defined as a *capacity,* must naturally have a functionally describable, and so scientifically amenable explanation.

In what follows, we will introduce a specific skill theory, namely the 'sensorimotor contingency theory' proposed by O'Regan & Noë (in press a). We will argue in some detail that it accounts for all the features of phenomenality — ongoingness, sensory quality, ineffability, etc. — that are usually considered difficult to account for in neurophysiological terms.

VI: Sensorimotor Contingencies

There are two basic ideas underlying the sensorimotor contingency theory, one involving the notion of sensorimotor contingency itself, and one involving the notion of awareness in the sense of having intentional access. We will start with sensorimotor contingencies.

Sensorimotor contingencies (one might also call them sensorimotor *dependencies* or *co-variation*) are the laws that link a perceiver's actions to the changes in sensory input that these actions cause. To give a first example of a basic sensorimotor contingency, consider a line. As noted by O'Regan & Noë (in press, a; cf. also Platt, 1960), what is typical of a line is that its projection on the inside of your eyeball remains identical whenever you move your eye along it, but changes drastically when you move your eye in any other direction. No matter what the optical properties or type of projection involved in the ocular apparatus is, no matter what the neural code associated with a line is (and it will be very distorted and complicated owing to non-homogeneous photoreceptor distribution and neuronal convergence in the pathways leading from eye to cortex), this law of co-variation is the same, and it is an invariant characteristic of lines. You are seeing a line if this sensorimotor contingency is currently applicable.

Now, *perceiving*, according to the sensorimotor contingency theory, is an organism's exploration of the environment that is mediated by knowledge of

[4] The idea that perceiving is the construction of an internal image or representation has always been dominant in vision science. The picture on the cover of this issue, taken from a treatise by the Arab medieval theorist Alhazen, illustrates how vision arises through reception and transmission of images through the various parts of the visual system. The separate images caught by each eye are recombined in the optic chiasma, where the two optic nerves join, and where the recombined image is perceived by the *ultimum sentiens*, or ultimate sentient power (see Lindberg, 1976, ch. 4 for more detail).

sensorimotor contingencies. For example, a perceiver perceives a line if her visual interaction with a line is guided by, or corroborated by, or coherent with, the sensorimotor contingency described above. With any exploratory movement that the perceiver makes, she has knowledge about how input will change, and this knowledge is never disconfirmed during her exploration. But note: the notion of 'knowledge' at play here is a notion of *implicit* knowledge. The knowledge of the sensorimotor contingencies is not an independent or separately stored item which is available to the perceiver, but it is *implicit*; present only in the particular ways the ongoing exploration unfolds. In fact, knowledge of particular sensorimotor contingencies should be understood as literally constituting a perceptual skill, analogous to a skill such as tying one's shoelaces. It takes shape as a specific type of co-ordinating of one's action with opportunities offered by the environment.

We have illustrated the notion of sensorimotor contingency with regard to the perception of a straight line, but the notion applies also at a much more basic level; namely at the level of 'sensory qualities' themselves.

According to the sensorimotor contingency theory, a perceiver perceives a sensory quality, such as the sensory quality of redness, if she hits upon, and lets her visual activity be guided by, the sensorimotor contingency that is typical for 'red'. To get an idea of what constitutes this sensorimotor contingency, consider the following facts about red:

- red objects have their characteristic way of behaving-under-motion with respect to light sources, and, importantly, changes in light sources. For example, the spectrum of light reflected back from a red surface changes in a particular red-specific way depending on whether you tilt the surface so that it is reflecting back bluish sky- light, yellowish sunlight, or reddish incandescent light. (cf. Fig. 1a [last page of this document])

- red objects have their own way of being 'sampled' by motions of the human visual apparatus. For example, due to inhomogeneities in retinal distribution of the different types of colour-sensitive cones mentioned above, red surfaces will offer a characteristic temporal 'fingerprint' when scrutinised by a moving eye (cf. Figure 1b [last page of this document]).

A way of capturing the idea of sensorimotor contingency with respect to redness is to say that 'red' is the way red things 'behave' when we 'prod' them with our visual apparatus.[5]

The notion of sensorimotor contingency also applies at the level of the sensory modalities. To perceive in a modality-specific way is to perceptually explore the environment guided by knowledge that is specific for that modality. In other words, particular sensory modalities are characterised by particular sensorimotor contingencies. The modality of the 'visual', for example, is associated with such sensorimotor contingencies as: the retinal image shifts in certain precise ways

[5] Cf. Merleau -Ponty (1945/1976), p. 243: 'Le bleu est ce qui sollicite de moi une certaine manière de regarder, ce qui se laisse palper par un mouvement défini de mon regard'. Our translation: 'Blue is what invites me to a certain way of looking, what lets itself be palpated by a specific movement of my gaze.'

when eye movements are made; it suffers drastic changes when blinks occur or when light sources are occluded; it is not affected by covering your ears. On the other hand, the auditory modality is characterised by the fact that moving forward increases sensory input intensity, moving one's head changes amplitude and phase difference of sensory input between the two ears; covering one's ears decreases sensory input intensity, but blinking has no effect.

The notion of sensorimotor contingency also applies at the level of object perception; for example, what characterises visual perception of a pitcher is that when you move around it, the handle appears and disappears. Seeing a pitcher involves, under the sensorimotor contingency theory, knowing that if you were to move, the changes typical of pitchers would occur in your sensory input.

VII: Awareness, or Intentional Access to Sensorimotor Contingencies

We now come to the second idea underlying the sensorimotor contingency theory. We have seen that at any moment during an organism's interaction with an environment, a countless number of sensorimotor contingencies are at play, and that these can be described at different levels going from those related to the nature of the sensory apparatus all the way up to those determined by object identities. However, clearly, not all of those contingencies are available to the organism's perceptual awareness. Relatedly, a missile following the twists and turns of a target might be said to be guided by sensorimotor contingencies, though it would make little sense to ascribe perceptual awareness to the missile. An additional ingredient seems to be necessary to capture perceptual awareness.

According to the sensorimotor contingency theory, a perceiver's becoming perceptually aware is a matter of it being able to deploy a further skill, namely the skill of integrating one's purely perceptual skills into one's intentional behaviour. The idea is the following: whenever a creature is in a perceptual situation, countless sensorimotor contingencies apply, and some of these are actualised by associated exploratory movements. But, either by being alerted by something significant that happens out there, such as a sudden movement, or a loud noise, or by the perceiver's own decision, one of the ongoing patterns of exploration is picked out and allowed to play a prominent role in the perceiver's ensuing actions. The perceiver bundles all the capacities she disposes of and reorganises them with respect to what thereby becomes the prominent theme of the ongoing perception (note that it might be prominent only fleetingly).What we call seeing then is: having intentional access to certain currently applicable sensorimotor contingencies.[6]

Two things should be obvious with respect to this account of perceptual awareness. First, it requires that perceivers have a complex intentional structure, in the sense of being able to engage in the rich and complicated set of interdependent actions that we call 'intentional' . Second, it is describable as an access- based

[6] The structure of the sensorimotor contingencies themselves remain implicit knowledge, however, the actual muscle commands and sensory inputs, the precise details of the sensorimotor laws remain, as such, unavailable to the observer.

account, for fundamentally it is intentional access that proves to be the clue to awareness.[7]

The sensorimotor account of consciousness thus attributes to intentional access the power of determining *whether* a content is conscious or not. The content or *what* of consciousness, however, is determined by the sensorimotor contingency. That conscious perception has the content it has derives from the specific sensorimotor contingencies at play.

VIII: Accounting for Phenomenality

Now that we've presented in general how the sensorimotor contingency tries to capture perceptual awareness, let us return to our list of phenomenal properties presented in section III, to see whether and how the theory accounts for them.

Consider first *sensory qualities*, such as the colour red. The problem with explaining them through correlated neural processes was that the link between the neural process and the quality was arbitrary. There seemed to be no reason why a particular neural process was associated with red rather than with green. Within the sensorimotor account, sensory qualities are not paired up with neurophysiological processes, but with packages of sensorimotor contingencies. 'Red' feels the way it does because seeing red is constituted by the particular pattern of exploring colours that is determined both by how red objects typically interact with light and by how the human visual system is made up. Red is what 'invites' a perceiver to go into the red-related mode of visual interaction.

Of course, one can always ask: 'But why is this type of exploration associated with 'red', rather than with 'green'?'. We think that, within the sensorimotor perspective, one can see why this question is groundless. For the question becomes similar to the question: why is walking like walking, and not like jumping? The only thing one can do to answer the latter question is to point out that walking is constituted by these particular kinds of movements, while jumping consists of a different pattern of movements. If one were to interchange the movements, walking would no longer be walking, but would become jumping. The same applies, we think, with respect to red and to green.[8] The crux, of course, is that the sensorimotor perspective doesn't take the red to be something different than the exploratory activity, but as coinciding with it.

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[7] Most other access-based accounts see access as something that has a neurophysiological or neurocomputational counterpart (for example, Baars ,1988; see also Clark, 2000a, p. 33). Access then gets identified , for example, with the becoming available for further processing of 'information'or 'representations'.

What distinguishes the sensorimotor version of the idea of access, is, first, that, within this theory, intentional access is not interpreted in subpersonal terms. Rather, intentional access is considered as similar to the perceptual mastery of sensorimotor contingencies, in that it is a spatiotemporally extended interaction of the organism with the environment. That an organism is conscious of a certain perceptual content means that the organism has obtained, and is currently exercising, a second-order mastery of her mastery of perceptual sensorimotor contingencies — a second-order skill of being able to integrate the first-order mastery in her intentional behavior. Consciously perceiving then becomes knowledgeable steering of one's perceptual interaction with the environment.

[8] For an application of such an approach to brightness perception, see Myin (2001).

Note also that the sensorimotor contingency approach easily accounts for the similarities and dissimilarities between sensory qualities; for example, the fact that red is more similar to pink than to yellow. According to the sensorimotor contingency theory, such similarities and differences are a consequence of the similarities and differences between the various sensorimotor contingencies that are involved. Roughly, 'red' is similar to pink because many of the laws that determine how red objects interact with various light sources also apply for pink objects, and many of the regularities that are appropriate for a perceiver's exploration of a red surface are also appropriate for the perceiver's exploration of a pink surface. Red and pink, thus, are similar in somewhat the same way that walking and running are similar.

The *sensory modalities* form another level of perceptual category characterisable by sensorimotor contingencies. As said, according to the sensorimotor contingency theory, the sensory modalities are what they are because they are associated with their characteristic set of sensorimotor contingencies.

Thus, sensory modalities form a unity and differ because they are associated with similar or different modes of exploration. In other words, vision is one sensory modality, and hearing another, because a particular set of exploratory regularities is appropriate for vision, while another one is appropriate for audition. To stick with our earlier metaphor, vision seems different from hearing just as walking is different from swimming: they are different things we *do*. It will be noticed that this characterisation of what makes for similarities and differences between modalities is exactly equal to the characterisation of what makes for similarities and differences between sensory qualities. Indeed, it seems to us that within the sensorimotor contingencies, there is no ground for a sharp difference between modality and sensory quality.

Now we can turn to the characteristics of *ongoingness, forcible presence, ineffability* and *subjectivity.*

Concerning *ongoingness*, consider a perceiver in a scene that contains a red object. Her eyes glances over the scene in a particular pattern that conforms to the sensorimotor contingencies at play. One of the patterns present is the pattern typical of redness: a pattern determined by how the red input changes with movements of the eye and with changing lighting conditions. For example, because red sensitivity is low in the periphery of the visual field (there are hardly receptors specifically sensitive to red there), the red input changes drastically once it moves from the focal to the peripheral part. Now, while casting her gaze upon the scene, she exercises her mastery of this and countless other sensorimotor contingencies. But suddenly, either by decision or by an extraneous factor, she devotes all her resources to the 'redness' that is present there. That is, she allows the particular pattern for red that she is going through to play a special role in the global activity she is engaging in. In other words, the 'redness' comes to dominate the ongoing actions of the perceiver, and therefore it is perceived as 'the ongoing event that is currently happening to me now'. Why does experience seem like it is ongoing? Because it is indeed something we are currently engaged in doing.

Forcible presence: One could be engaged in *remembering* one's grandmother and this would be an ongoing experience. But it would not provide the same kind of real sensory experience one gets from actually *visually* contemplating one's grandmother. This difference between sensation and other mental states we have called forcible presence. It, too, can be accounted for in the sensorimotor contingency approach by virtue of the fact that sensory systems provide what O'Regan and Noë (in press b), have called 'grabbiness' and 'bodiliness'. 'Grabbiness' and 'bodiliness' are complementary aspects of the way sensory systems operate, pertaining to changes in sensory input or in the environment in relation to a perceiver in this environment.

'Grabbiness' is associated with the tendency something has to attract or grab a perceiver's attention. Because of the presence in the first levels of the human visual system of neural circuits that are sensitive to sudden changes in luminance or position, sudden changes in a visual scene will immediately activate these low-level 'transient detectors' and so cause attentional resources to be automatically and incontrovertibly directed to the location of change. We say that vision possesses a high degree of 'grabbiness'. The phenomenon of change blindness, to be described in section XII, is an illustration of what happens when, in certain circumstances, this attention-grabbing system is prevented from operating normally.

'Bodiliness' refers to the complementary aspect of how much the input to the perceiver's perceptual apparatus will change when the perceiver moves. The greater these changes, the higher the degree of 'bodiliness'. 'Bodiliness' thus provides a measure for how intimately linked to its environment the perceiver and its perceptual apparatus are.

Perception, then, has forcible presence because it has both high 'grabbiness' and high 'bodiliness'. That is: if you are currently seeing your grandmother, any movements your grandmother makes will immediately be noticed and will engage your visual attention (high grabbiness). Similarly, any movements you make while perceiving her will drastically change the sensory input related to her. In other words, the high grabbiness and the high bodiliness 'bind' a perceiver to what is perceived and vice versa because it assures an impact of what the object 'does' on you and an impact of what you do on the object (as perceived, that is). Thus, the object is forcibly present, simply because any change it makes alerts you and because any change you make affects the sensory input deriving from the object.

Contrast this with merely remembering your grandmother. None of the movements that your (non-present) grandmother makes will reach you and none of your movements will lead to a change in incoming stimulation that has anything to do with her. From this follows the 'realness' of visual perception and the 'faintness' of mere memories.

Ineffability, or the property that you can never adequately describe what you are conscious of, poses hardly a problem for the sensorimotor contingency theory. For the theory says the perception of red is like the exercise of a skill. One can't adequately describe all the knowledge that underlies a skill (think of walking) and exactly the same goes for experiences such as seeing red.

Finally, consider *subjectivity.* We've suggested above that a way to characterise 'subjectivity' is to say that it consists in the fact that consciousness is for the subject. It is to the subject that consciousness occurs, and it is fully available to her or him as an opportunity to act (upon what is perceived).

Subjectivity and 'being for the subject' are naturally taken care of in the sensorimotor contingency theory because in it, perception and awareness are *defined* in terms of potential for action. Someone is perceptually aware of something because she is interacting with it. It is her putting all the resources she has onto whatever she is conscious of that makes her conscious of it. So, once she is conscious of it, it is 'for her'—it is her subjective project to which she is devoting all her capacities. So, consciousness is, by definition, 'for the subject'.

IX: Applications and Illustrations of the Sensorimotor Approach

We have shown that the sensorimotor theory is a way of conceiving of perceptual consciousness, which provides a naturalistic approach to those aspects of the phenomenology of perceptual experience which have generally been considered impervious to scientific explanation: in fact, those aspects which Chalmers refers to as constituting 'the hard problem' (Chalmers, 1996).

As a further advantage of the sensorimotor approach, O'Regan & Noë (in press a; b) have also shown how the theory connects a number of previously unconnected strands of work in the psychology of perception, and makes interesting empirical predictions, some of which have been or are being confirmed. In the following paragraphs we will illustrate this by looking at some of the empirical consequences of three key concepts of the sensorimotor theory, namely the notions of skill, sensorimotor contingencies, and grabbiness.

X: Skill and the 'Feeling of Seeing Everything'

O'Regan (1992) has noted that the 'real mystery' of visual perception could be considered to be the fact that the visual system suffers from a variety of what might be taken to be serious defects, but which people are quite unaware of: There are strong retinal inhomogeneities (different classes of receptors are distributed unevenly over the retina). There is the very large blind spot and the vascular scotoma, caused by the fact that the blood vessels that irrigate the retina lie on the anterior side of the retina, obscuring vision. There are various optical defects which, if they existed in a normal camera, would render it useless. Finally, there are eye movements, which create smearing and shifting of the retinal image all the waking day at a rate of about 4–5 times per second. Nevertheless, our visual impression of the world is stable, unitary, detailed, rich and complete. We have, when seeing a scene, the feeling of seeing everything in the scene in full detail.

In order to explain the apparent quality of vision despite these numerous defects, under the traditional view of what seeing is, it is necessary to postulate appropriate compensation mechanisms so as to create a 'perfected' internal representation of the outside world. Thus, an abundant literature exists concerning a 'filling-in' mechanism that might interpolate across scotomas like the blind spot so that no 'hole' should be visible in our visual field. Another proposed compensation mechanism that has received considerable interest is the so-called 'extra-retinal signal', which is a hypothetical signal coming from the eye muscles or from the command centres that control them, and that might be used by the brain to shift the internal representation back into place so that the world appears stable after eye movements. There is also much work that has been done on the notion of 'saccadic suppression', in which it is supposed that, since the brain 'knows' that it has generated an eye saccade, it should be able to 'suppress' the retinal smearing that would normally ensue, and thereby guarantee a high-quality internal image. O'Regan (1992) has catalogued this literature.

Other similar mechanisms might logically also be postulated for defects like the chromatic and spherical aberration of the eye, as well as the differences between the way central and peripheral vision are sampled, both as concerns spatial acuity and colour quality.

But from the point of view of the sensorimotor contingency theory, this plethora of compensation mechanisms is unnecessary. Instead of building up visual detail in an internal 'memory buffer', the sensorimotor approach supposes that perceivers leave the detail where it originates — in the world. Whenever a perceiver needs some detail she simply consults the world by interrogating it; by turning to the detail and visually 'manipulating' it. Under this view, the impression of richness and detail in the visual world—the feeling of 'seeing everything'—derives, not from activation of a detailed internal representation, but from the mere fact of *having implicit knowledge of the availability*, at the slightest flick of the eye, of any particular aspect of the scene. *The 'feeling of seeing everything' thus comes from the implicitly acknowledged exercise of a capacity to gain information by visually exploring the outside world.*

O'Regan (1992) used a tactile analogy, borrowed from MacKay (1967; 1973) to illustrate the view: when holding a bottle in one's hand, one has the impression of feeling the whole bottle rather than only feeling the parts of the bottle that are in actual contact with the fingers. The tactile impression of the whole bottle seems to be provided by the fact that one's ongoing manual exploration of the bottle is unfolding along the acquired 'bottle recipe': through the fact that one knows that if one were to move one's hand up or down one would receive precisely those changes in tactile input that are typical of bottles. The phenomenal experience of 'feeling the whole bottle', then, comes from implicit knowledge about what would happen if one were to make certain exploratory movements. So, the impression of feeling the whole bottle is, at a smaller scale, analogous to the 'feeling of seeing everything' in a scene.

It should be emphasised that the correct interpretation of this account is not that you see only small parts of the visual scene at once and that the feeling of seeing everything is an illusion. The idea is not that, instead of internally representing the whole scene, you only internally represent small parts of it, which then get mentally blended. The idea is that you are literally *seeing* the whole scene in front of you, because *seeing* is nothing other than *knowing you can explore* the scene. In fact, the parts of the scene which are currently in your blind spot or in low-acuity parts of your visual field are seen by you in the same way as you are seeing the other parts — because of the way you are interacting with them. Hence, the impression of seeing everything.

Applied to the question of the 'filling in' of the blind spot, this view takes the following form: just as we do not have the tactile feeling, when holding an apple, that there are gaps in the apple where there are spaces between our fingers, we do not have the impression that there is a hole in our visual field where the blind spot is. This is because seeing *is in the doing*: in the 'feeling-at-home' with the changes that take place when you move your eyes around the visual field, just as feeling the apple is in the feeling-at-home with the changes that take place as you move your fingers over the apple. Similar arguments explain why there is no need to postulate compensation mechanisms for imperfections in the visual apparatus due, for example, to sampling inhomogeneities or eye movements.

O'Regan & Noë (in press a) also point out some further interesting empirical consequences of the skill-based viewpoint. In particular, the notion that the phenomenology of seeing necessarily involves intentional access implies that despite our 'feeling of seeing everything', those aspects of the world which are not currently being visually accessed, or 'manipulated', should not in actual fact be available for accurate report. Thus, though people may have the impression of seeing everything in front of them, it should be the case that in fact they actually do not have conscious access to everything. Indeed, a number of recent studies of what Mack & Rock (1998) call 'inattentional blindness' confirm this idea. The most striking demonstration of this is perhaps the work of Simons & Chabris (1999), using a paradigm pioneered by Neisser & Becklen (1975). In an example of this technique, a video sequence involving two teams, each playing with a ball, is shown to subjects who are asked to concentrate on counting the number of times one team exchanges the ball. An actor dressed in a gorilla costume walks in full view across the scene while subjects engage in this task, which requires some concentration. In many cases observers do not see the gorilla, and are incredulous that they should have missed such an obvious occurrence when shown the video sequence a second time. Further evidence suggesting the need for intentional access in order to see is provided by O'Regan & Noë (in press a), taking examples from figure ground competition, difficulty of detecting spelling errors, as well as other examples where an observer can be looking at something without seeing it.

XI: Sensorimotor Contingencies and Sensory Substitution

A second key notion in the sensorimotor approach is the idea that it is not the neural channel via which a sensory stimulation occurs, nor the brain area that is stimulated, that provides the sensory quality of a perceptual experience, but rather the laws of sensorimotor contingency that the observer is currently accessing.

As pointed out by O'Regan & Noë (in press a), a very interesting and counter-intuitive prediction can be derived from this: it should be possible to obtain sensations that are qualitatively similar to visual sensations via other sensory input channels provided the laws of co-variation between body motions and sensory input are similar to those of the visual modality.

That this should be possible is suggested by experiments on sensory substitution. A variety of such devices are currently receiving renewed attention after a period of disinterest. The initial studies of Bach-y-Rita and collaborators (1967; 1972) showing that blind persons equipped with arrays of tactile vibrators interfaced to video cameras could achieve a certain feeling of 'vision', are now being developed with tongue-based stimulators (Bach-y-Rita *et al*., 1998).

Another intriguing result in relation to the idea that the quality of sensory phenomenology should be provided by sensorimotor co-variation is the result of Botvinick & Cohen (1998; see also Ramachandran & Blakeslee, 1998), showing that the felt location of tactile stimulation can be displaced from a person's actual arm to a rubber arm placed in an adjacent location. During a training period the experimenter strokes the subject's real arm, hidden from the subject's view, and simultaneously in exactly the same way, strokes the rubber replica, which the subject sees in front of him. A new sensorimotor contingency between the tactile sensory input and the visually perceived locus is thereby established, with the consequence that after about 10 minutes the subject actually feels the stimulation *on the rubber arm*.

The idea that the phenomenology of sensation is the result of sensorimotor contingencies is also coherent with a number of other results in the literature on sensorimotor adaptation, where it is shown that when subjects adapt to rearrangement of sensory systems through the use of prisms, mirrors, or coloured spectacles, the adaptation is generally restricted to the sensorimotor loops that are immediately involved, and does not generalise to the perceptual modality as a whole. Instances are, for example, Kohler's (1961) classic experiments, where a person wearing left–right inverting goggles for a few weeks will adapt in a piecemeal fashion, going through periods where in the same spatial location an object can appear somehow both correct and inverted: for example, an automobile might be seen on the correct side of the road, but with its licence plate written in mirror writing. This would be accounted for in the sensorimotor approach by saying that there is no coherent image-like internal representation of the visual world: the orientation of writing and the location on the road of the car are constituted by such things as the possibilities the subject has to read and write on the one hand, and to orient his gaze on the other hand, and these may correspond to sensorimotor sub-systems which may adapt independently to the rearranged vision.

XII: Grabbiness and Change Blindness

Another key notion in the sensorimotor approach is the notion of 'grabbiness', which is, according to O'Regan & Noë (in press b), with bodiliness, what provides the explanation of why perceptual experience has its distinctly perceptual character. If there were no grabbiness and bodiliness of sensory systems, then access to information in the world would be no different to access to information stored in an observer's memory. Grabbiness is one of the characteristics of sensory systems that gives an observer the impression of continually 'having tabs' on her perceptual world, thereby providing the feeling of continual presence and intimate contact with the perceptual environment.

Artificially interfering with the grabbiness of visual stimulation is the principle underlying a recent flurry of experiments concerning what is called 'change blindness'. In such experiments, people are shown successive pictures of a scene in which some rather large changes have occurred. In one setup, a blank is shown between the display of the original scene and the display of the scene with changes (Rensink *et al*., 2000). In an alternative setup, several large spots are very briefly superimposed on the picture, like mud splashes on the windscreen of a car (O'Regan *et al*., 1999). Other paradigms involve the successive images being separated by blinks, eye movements, film cuts, or even real-world events like workers passing in front of you holding a door (for a review cf. Simons, 2000; Video demonstrations are available on http://nivea.psycho.univ-paris5.fr; and on http://www.wjh.harvard.edu/~viscog/change).

What is observed in these experiments is that very large changes are often not noticed. Moreover, the experiments come as a surprise to participants, since they seem to show that contrary to the impression they have of seeing everything in front of them, in fact they take in much less of the visual world than they think. The explanation of the effect, from the point of view of the sensorimotor theory, is that usually the changing element in a scene will produce a 'grabby' luminance or colour transient in the visual field that attracts attention, and causes you to notice the change even if you happen not to be currently 'visually manipulating' the element that is changing. But in the conditions of the experiment, the disturbance (flicker, mud splash, etc.) intervening at the moment of the change, because it creates a large number of additional transients in the scene, will have the effect of drowning out the transient due to the sought-after change in the picture. The change will then only be seen if it happens to be the aspect of the scene which the observer was attending to at the moment the change occurred.

Another experimental paradigm which illustrates the importance of grabbiness in visual scene perception is the 'slow change' paradigm (Simons *et al*., 2000; Auvray & O'Regan; 2001, submitted). Here, a change in a picture is made sufficiently slowly that visual transients are so weak that they do not cause any grabbiness. As a result, again, very large changes occupying a significant fraction of the picture area will not be seen unless the observer happens to be attending to the changing element. (Video demonstrations of this 'slow change' phenomenon can be viewed on http://nivea.psycho.univ-paris5.fr).

XIII: Conclusion: Naturalizing Phenomenology?

We hope to have shown how, within the skill theoretic approach of the sensorimotor contingency theory, one can account for phenomenality while at the same time accounting for access to modality. We thus hope to have fulfilled our promise, suggested in the beginning of the paper, of assembling the pieces Clark has brought to the playing field into a satisfactory access-based explanation of phenomenal consciousness.

We have argued that one can capture phenomenal consciousness through access consciousness if one takes seriously the skill theoretic perspective. Under this perspective, access is construed as intentional access of an active organism to its perceptual capacities rather than being identified with a physiological or computational process inside its brain.

Contrary to Clark, we've defended the view that it is skill-mediated intentional access to sensorimotor contingency in general, rather than access to modality alone, that is crucial in this approach to phenomenal perceptual consciousness.

In fact, though further work must be done, we hope to have shown how, in particular, the sensorimotor contingency theory (O'Regan & Noë, in press a; b) offers a framework in which a beginning can be made towards 'naturalizing' phenomenology.

Of course, many of the characteristics of phenomenal consciousness listed in section III have been thoroughly investigated by such writers as Merleau-Ponty (1945/1976). We concur with the criticism, present in this tradition, that a reductionist approach, in which direct identification of the phenomenal with the neurophysiological is attempted, is doomed to perennial failure. On the other hand, we think a skill-based approach, which orients the science of perception instead towards *capacities* deployed by organisms, rather than to momentary internal events in their brains, holds out the promise of turning the phenomenologist's insights into a successful, yet broadly naturalistic research programme.

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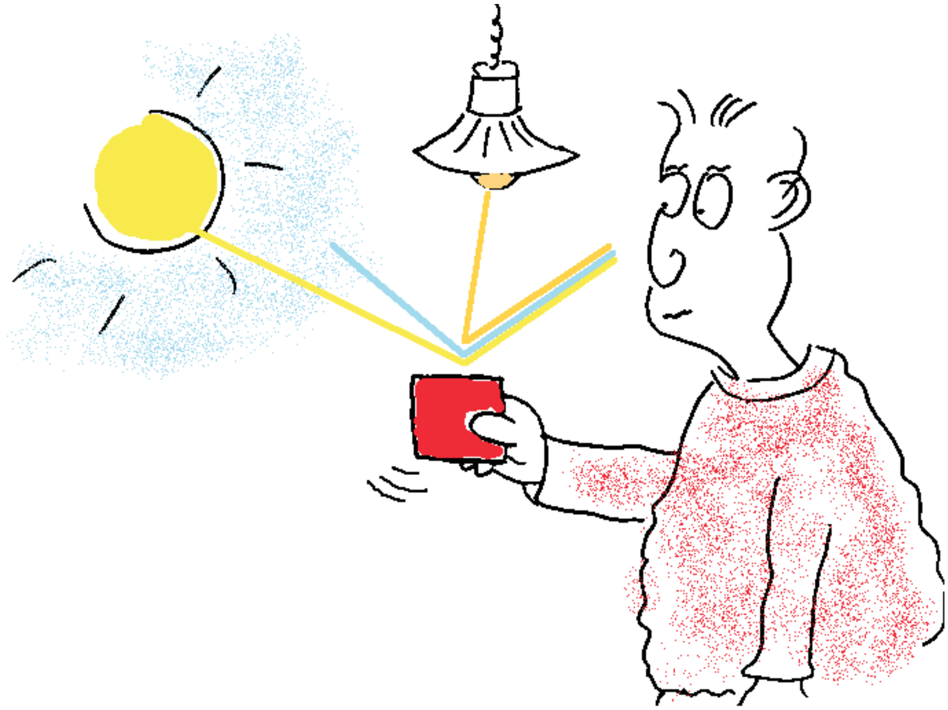

Figure 1a The spectrum of the light reflected from a coloured surface depends on whether more yellowish sunlight, bluish skylight or reddish incandescent light is impinging upon it. Colour is not determined by the incoming specturm of light itself, but by *the law determining how the spectrum changes* as you turn the surface.

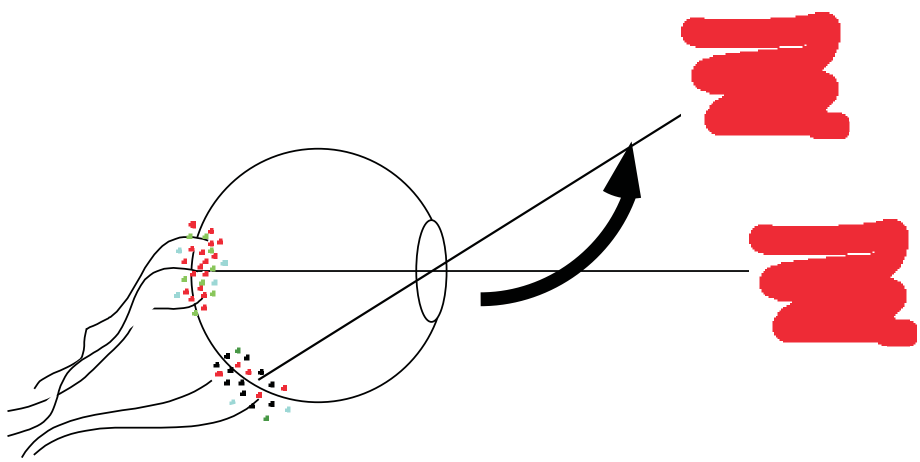

Figure 1b When the eye fixates a coloured patch directly, it will be sampled by densely packed photoreceptors sensitive to short, medium and long wavelengths of light. But when the coloured patch is viewed in peripheral vision, the photoreceptors are distributed differently and less densely. The sensation of a particular colour is not simply due to the excitation of different cone classes, but also to the distinctive laws governing how eye movements change the pattern of incoming sensory stimulation