Short analysis on the role of sensorimotor invariances as presented in the theory proposed by O'Regan and Nöe in three texts.

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To professor Kevin O'Regan, in June 2000.

Prelude

In this work we will consider two main theses proposed by O'Regan and Nöe. The first is that the concept of sensorimotor contingencies can be expand to include not only 3D spatial relations but also sensorial and recognition abilities. The second thesis tries to apply this hypothesis to the philosophical problem of explaining qualia (the so-called explanatory gap).[1] The authors also try to take some evidence for their theory for the purported advantages in solving this problem. We will analyse these two assertions separately.

NOTE: In this work we will not use the standard term 'sensorimotor contingencies' because it is too absurd. As we were writing the work it became patent that, by itself, this terminology created more obscurities than any other problem in the paper. Note that, by definition, something contingent is something that cannot be predicted, something to which a law cannot be applied. But all the talk of sensorimotor contingencies refers to the finding of invariances between sensor inputs and motor outputs. Although there is a cost in eloigning from the accepted vocabulary, since this is just an unimportant work not intended for a large audience, we will use always the term 'sensorimotor invariances' (with exactly the same meaning).

In this work we will look carefully at three texts by Kevin O'Regan and O'Regan and Nöe, they will be called STM, SA, and ST.[2] It seems clear that there is not in any one of these texts a single argument to be defended but several ones, their interconnectedness does not, however, appear perfectly clear, and here we will contend that there are in fact at least three separate arguments, and that each of them can be upheld or refused for independent reasons.

The arguments are the following:

1. Mastery of sensorimotor invariances plays the key role in a proposed new framework that is able to make new and unexpected predictions and give a better account for sensation, perception, awareness and consciousness.
2. The world as an outside memory: i.e. the idea that we do not keep a detailed internal representation of the world 'in our heads' but that we constantly recur to observation as a kind of external memory.
3. The upholding of a philosophical perspective according to which phenomenal experience, or I-qualia, or first person experience, cannot be addressed appropriately by science or philosophy. In this perspective all we can is to achieve more useful definitions, i.e., general frameworks that are able to suggest better experiences and integrate current knowledge in a more coherent and economical way. Putting it shortly, all that is being done by people like Chalmers, Hameroff, Velmans, and many others is pure rubbish.

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[1] There is also a third thesis that we won't analyse: the world as an outside memory. See below.

[2] **STM** (Seeing as knowledge: Towards a scientific theory of visual qualia), **SA** (A sensorimotor account of vision and visual consciousness), **ST** (What it is like to see: A Sensorimotor Theory of Perceptual Experience). Notice that SA as been reformulated by the authors, our references here will always be to the first version of this text.

Although it seems to us quite clear that these theses are quite independent from one another (although definitely interconnected) we will not put much weight on this. Instead we will try to clarify several key notions that are at the root of the first thesis. (Notice that, in what follows, we will only probe the first thesis, not the other two. More specifically, what we will say cannot be taken as an argument about the value of Ryle's perspective.)

We have spend a lot of time trying to clarify in our head the ideas presented in these texts. Specially impenetrable (to us) was the idea of potential knowledge, developed in the STM and omnipresent also in the SA and ST. Although in the STM O'Regan is quite clear on presenting what it is not,[3] it is very difficult to understand what it is. The other texts (SA and ST) don't help, and, in our view, the connection made in those latter texts with functionalism, just takes away what could be original in this first formulation. We won't dwell into this now, however, instead we are going to highlight the first consequences of our own attempts in clarification (which have apparently lead us to eloign from this issue).

So, we have just dedicated our reflection to a few points in O'Regan and Nöe extended and detailed discussion, but, even so, our results are so far off from their presentation, that we expect this work to say something of importance, either regarding future versions of mastery of sensorimotor invariances either regarding how much I still have to learn until I master this particular theory!

So the work is divided into three parts. In the first part I present some reasons for upholding that action is necessary for constructing a representation of 3D space, in the second part I discuss some difficulties in defending the expansion of the role of sensorimotor invariances to also cover sensation. On the last part I will try to show that the philosophical underpinnings of O'Regan and Nöe (and shared by other people like Dennett, Ryle, and others) don't work to support their theory.

[3] Potential knowledge is not: information, coding, representation or prediction (cf. §§ 3.3 – 3.5) We still thing this is one of the central notions of the theory and that it should be better worked out.

1. *Exposing sensorimotor invariances.*

In the three texts under analysis here, sensorimotor invariances are presented in the context of the explanatory gap. That is, of the difficulty of explaining phenomenal qualities through the description of physical states and properties. For reasons that will become clear we will not follow this standard presentation. Instead we will begin by what appears to us the central claim of the theory. However, before we start we should add a caveat, we will propose in the following lines several alterations to this theory, however, our main formation is in philosophy. We do not know enough of the actual experiments and relevant bibliography to have a complete and detailed view on the subject. But, even so, we are convinced, from logical reasons, that the perspective to be presented in this paper cannot be too far off from the truth. It will be not our task, however, to give more than a draft of this view and to show the new ways that it opens to research.

Two classes of sensorimotor invariances:

O'Regan and Nöe divide sensorimotor invariances into two separate classes, the ones the mastery of which gives rise to spatial relations and the ones the mastery of which gives rise to phenomenal properties.[4] From ST and STM it appears that the first class is well known in the literature.[5] It is a conviction explored in this paper that there are good reasons, both from experimental evidence and conceptual analysis, to think that movement (and, in a sub-set of cases, action) must (for logical reasons) accompany the perception of spatial relations. However, during the course of our reflection in these themes, we have grown reluctant in accepting that sensorimotor invariances could play a similar role regarding colour sensation or qualia in general. Our reluctance does not derive from the impossibility of that relation to occur but of the fact that no convincing experience or argument was presented that supports that thesis. Furthermore, if the restriction that so clearly appears regarding space was to be extended to phenomenal qualities this seems to have (or so we will defend) negative consequences for the clarity and simplicity of the resulting theory. We will therefore, on the following paragraphs, not put much weight in a detailed description of every experience and argument that can be put forth regarding the first class of sensorimotor invariances, but we will only present them in the measure that they will be important to our arguments regarding the difficulties associated in the second class.

2. *Action and 3D space.*

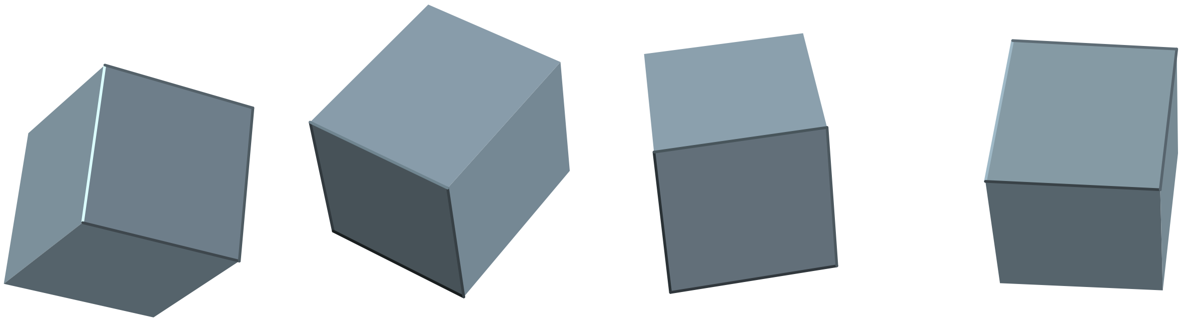
The basic idea behind the mastery of the so-called sensorimotor invariances can be summarised in the following way:

[4] "We have distinguished two classes of sensorimotor invariances that are typical of vision: one that is a consequence of the structure of the visual apparatus, and one that is a consequence of the nature of 3D space." (ST, §2.4). If we have well understood O'Regan & Nöe terminology, there are only two 'classes' but several 'kinds' of sensorimotor invariances. 'Classes' distinguish between spatial and phenomenal sensorimotor invariances and 'kinds' between olfactory, tactile, visual, etc, sensorimotor invariances (Cf. SA, §3.8, 6th paragraph)

[5] The most ancient references given by O'Regan are Lotz (1852), Poincaré (1905) and Husserl (1907). For more references and other details, see STM, pp. 6, 8 and 9, and ST §§ 2.4 and SA §3.8.

> "[Although] we are not able to describe all the changes that a convex surface should suffer or the distortions that should occur on moving our eyes to all sorts of positions on the surface, or when we move or rotate it […] our brains [nevertheless,] have extracted such laws, and any deviation from the laws will cause the percept of the surface's shape to be modified." (SA,§3.3)

The central idea is therefore that, behind the (apparently) contingent changes in our sensory apparatus, there is same kind of lawful relation between those changes. Suppose for instance that we were in a universe in which there was only shaded cube (and a light, of course). This cube rotated, so, it appeared in several different ways like for instance:



Now, it is a trivial point that, to subsume all these different sensations into a single concept we must find what is invariable in all them. We can do that by generating a 3D image of an object that, singly, would result, by rotation, in all these 2D results. It is quite easy to turn this into a mathematical formula. We have a set of results, a function (rotation), and an invariant (the 3D object). When we apply the function to the invariant we get a set of results (the 2D picture) that depends solely on the value of the function. Conversely, we get the value of the rotation just by looking at the picture, as long as we have the invariant.

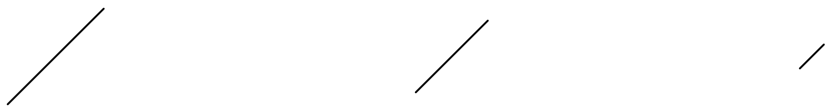
All this seems quite harmless, the wall we see, the sofa, the floor, etc, can all be considered to be names for invariants whose appearance (but only the appearance) change when they are displaced or when we move. In the same way, if we do not move but the result is changed in a way it is not predicted by the invariance, it must mean the invariance must have a new value and also that the object has changed (it might have diminished or melted, etc). It is simply to see that 'invariances' and 'objects' are in this sense two different names for the same thing. So, just by applying a very simple function with three main parts we get the whole world.

θ (Invariant) → result

or

function (reality/objects) → sensation

The big problem, of course, is getting two of the three parts fixed. Suppose for instance that we would only get a grasp on the result. This would be easily imagined if you assumed you were in a changing world in which you had absolutely no intervention. In that case a succession of images would appear, lets suppose something like:

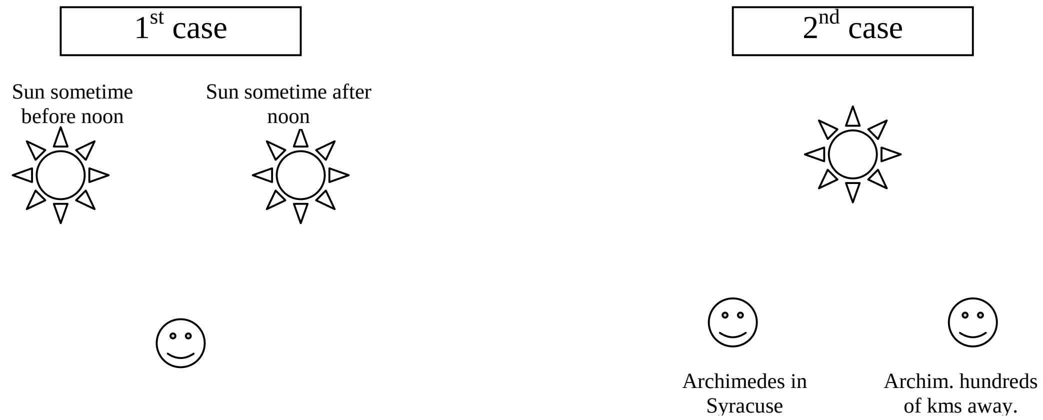


Now, this could mean a lot of things, for instance it could be a line that recedes, or it could be a triangle rotating (following the Flatland spirit!), a set of unrelated points, or even a shrinking line. The only way to choose from a number of possible infinite options is to have control on two of the three parts of the equation.

In more natural terms suppose that you received a faint visual stimuli in the retina. This could either be from a distant star to a very faint led. But, when this stimuli, passing the retina, would get into the brain, how would you know that it was the product of an external source at all? It could be something passing over the retina and causing the stimuli or just some arbitrary firing of brain cells.

Again, the problem is making two of the three variables known. We'd like to propose that Archimedes was the first to apply this principle to interplanetary exploration. Lets use his experiment to get more on space is discovered from action.

Imagine that you would want to know the distance that separates us from the sun. From ancient times there as been several proposals, but they were just wild guesses. The first person to have a true notion of the magnitude of that distance was Archimedes who walked hundreds of kms to get a different perspective of the sun at the same time of the day. How did this help him to sort out the distance from the Sun to the Earth? Well, it gave Archimedes an extra information. Lets see the diagram:



Now, the two situations are geometrically alike. In both of them we could build a triangle (in both cases we would know the triangle internal angles by measuring the shade projected by a stick, etc) and, using Pythagoras theorem, find a correlation between all the sides (and angles) of it. However, in the first situation the distance sun-earth remained unknown in the two observations. In the second case Archimedes knew the distance he had walked and therefore he could calculate the other two.

Suppose now a more bizarre thought experiment. Suppose someone (let's call it Carol) was born blind and to correct this defect we have connected the optic nerve to a standing camera. The camera was directed to a crowded street so that there were no boring moments but it was completely immobilised. Now, would Carol learn to see with such an apparatus? We think that several experiments suggest a negative reply. In conceptual terms we can understand this if we ask how could Carol ever associate the alternation of stimuli in is optic nerve with any reference. She could not change the position of the camera, or in any other way interact with the scene. Contrary to Archimedes, that could run away and see how the sun seemed to stand still passing fast behind the trees, Carol would not have any way of giving a meaning to her inputs. For all she knew those signals could represent an object in her skin, a fluid full of impurities or something completely different. There was simply no way of knowing, because, self-movement being completely excluded, all the other spatial relations remained equally ignored. Why should that happen?

We have gave several reasons to show that spatial relations cannot be normally known without the possibility of action. This could suggest that the concept of space is conceptually connected with the concept of action or movement. But this is trivially false. We can easily imagine a 'God's point of view' that apprehends all space at once, and without the need to move around. This is also the perspective of the geometrician. Geometrical space does not need action to be represented, it is a contingent fact that we, as a species, do need to have action to find the representation of space. It is not a logical requirement, merely a consequence of the way we are built.[6]

To put the point in a more formal way. Space demands the ability to move or – if we abolish time – the ability of objects to have different alternative positions. One dimension means that objects can go along one point to the other. And 2D mean that objects can go from one set of points to other set. But although space (added to time) implies the possibility of movement, it does not require necessarily the possibility of *self-movement*.[7] To put the point even more clearly, knowing an object (i.e. an invariant) implies the ability to know how it can change, not necessarily the ability to change it. (Space allows movement, it does not require movement.) The fact that, in practice, the two are associated is a consequence of our way of learning about reality (perhaps of programming our synaptic weights!).

So, although space, at first sight, might seem just the *ability to act* in certain ways it is in fact just the possibility of action (or of having alternative positions, time excluded). In a more poetic mood, we could say time and space are analogous to freedom (alternative possibilities) and objects are the actual constraints (particular choices from a set of possibilities).

3. Sensorimotor invariances applied to sensations.

Experimental results.

Although O'Regan to see their theory as able of being proved or disproved by particular experiments (in STM: § 5.1)[8] it seems difficult, to deny the importance of action to grasp a 3D representation of the world, if we take into account certain experiments: The inverted

[6] Some animals seem to be able to move with perfect mastery in their environment as soon as they are born. One such example is provided by the common Guppy (aquarium) fishes, which must run away from their hungry mother (and other predators) as soon as they get out of her belly!
[7] The use of 'movement' here can be replaced with 'alternative positions' in a timeless perspective. But I thought things were already complicated enough without adding timeless worlds to our discussion.
[8] Cf. also the conclusion of ST, although O'Regan and Nöe are not so clear on this.

lenses experiment, the sensory substitution of the visual by the tactile perception, and other results turn difficult not to take the mastery of sensorimotor invariances seriously.

Until now we have come across solid and clear examples, but they all address spatial relations. We don't think that the examples concerning colour have the same standing. For instance, it seems clear that experiments with sensory substitution[9] show unmistakably that spatial relations may easily be reproduced by structural sensorimotor similarities, but they do not say anything regarding colour sensation. O'Regan clearly presents this point when he says for instance:

> "It is clear that while such [echolocation] devices obviously cannot provide visual qualia, they nevertheless provide users with the clear impression of things being "out in front of them". (STM, p.35).

What this example of the echolocation device and similar ones show is also that this ability to localise things in space is not restricted to 'external' objects but also implies a definition of our own body.[10] When driving we can sense ourselves inside the car, grabbing the steering wheel, etc. But we can also feel the wheels and the dimensions of the car, and drive from that perspective. In that way, while parking, we can be either 2 meters away from the next car (if we are in the seat) or just 2 cms away (if we are in the car)! To change from the driver to the car perspective all we have to do is to change the set of sensorimotor invariances rules that we are using. So, instead of moving the steering wheel we move the wheels, instead of putting the foot on the break we simply break, etc. The localisation of exterior objects cannot be made unless the boundaries and position of the body is also made, and these are correlated. Changing the boundaries of the body will also change the relative position of the objects, so that our description must be re-described in order to yield the same relations. This can explain both how we feel the rubber of the tires grabbing the road, and how we feel sensation in our fingers. But nothing of this applies (or is intended by O'Regan to apply) to colour perception. The same happens with the experiments made by Bach & Rita. While discussing these experiments O'Regan also concludes that "The invariants related to position and size changes of the tactile image are similar to those in normal vision. Colour and stereo vision however are absent" (STM, p.37). The same could be said of the 'facial vision of the blind'. The feeling the blind person has is connected also with a spatial property.

<u>Conceptual problems.</u>

But, besides the lack of experimental results there is also a conceptual difficulty in accepting that sensorimotor invariances can be applied to sensation. Sensorimotor invariances, like the name indicates, are invariances found between motor actions and sensory inputs, but if sensation is itself an invariant, than it cannot be an invariant found through the use of sensation, since, trivially, every sensation used to find the invariance would itself needed another previous relation as its cause (which would lead to an infinite regression).

At first sight this might seem an illusory problem derived by using 'sensation' in two quite different senses.[11] In everything we've said so far we have just spoke of cognitive abilities.

[9] For a discussion of tactile/visual replacement see STM, pp.35-39, SA §5.13-5.15,

[10] In our view the interdefinability of the representations of space, movement, self-representation and action, is one of the most important consequences of the theory.

[11] It is very clear why the authors start immediately talking of sensation as the product of sensorimotor invariances; in fact they want to start by showing the advantages their theory purportedly has in helping to solve

The ability to find a mathematical invariant that makes a one to one correspondence between a set 'a' and 'b' one of which we call outputs and the other inputs. But nothing of this requires a 'first person' perspective. It would be very simple to implement a computer program that would find invariances between, let's say, inputs from a photo sensor device and command of a light bulb. This invariance is just a fixed quantity to which, when a function is applied, yields a certain output or (with a different function) a certain input.

The introduction of the term sensation here is prone to introduce some degree of confusion, in fact it seems, as long as we are speaking about invariances, that there is no need to speak about sensation. More than that, there is no reason to speak about sensation. Because sensation is, at least in ordinary language, connected to qualitative features of experience (phenomenal or first person experience). Do we have reasons to claim that (phenomenal) sensation should (or must) be correlated with some sets of invariances? Or even to all invariances? But his would be absurd. If I would make an equation in my computer which involved an invariant should I say it has an associated sensation? Or is it the motor control that gives it that character? But what kind of argument can we have for upholding that? Whatever the argument might be, it seems clear that it will be somewhat speculative (or revolutionary). In this part of our text we will just deal with the experimental part of the proposal so we will avoid the word sensation. Instead we will stick to the term 'invariance' and we will try to apply it to shades and so on.

In fact it does not seem too difficult to make a robot for instance that gets a shade invariance from a set of perspectives. Because the an object with the same shade reflects differently according to the amount light projected on it, it is natural to think that the construction of an invariance regarding shade would provide us a better description of reality. It would be able to give us a single number for an array connected inputs. Which has the obvious advantage[12] of the system using always the same number for the same unchanging surface.

Suppose we were to apply a scale for 0 to 256 shades of grey to any given picture. Suppose the picture is given to a computer by a scanner. In a normal recognition program the shade number is directly proportional to the quantity of black and white present in any given pixel. But even in a rudimentary invariance system, the program looks at all the image, evaluates the total amount of brightness and adjusts the result trying to get a more satisfying result (this is what actually happens if you turn the 'automatic exposure' (or equivalent) option activated in your favourite image processing program). In practice this would mean that if you took several pictures during the day to the same room, although you might get darker and darker pictures as there was less light available, the program would make the correction and would give always a similar output result.

The use of filters in the photo sensors can be of use to discriminate objects more accurately. For instance, modern scanners have filters in they photosensors, which means that some sensors only capture some frequencies of light. This allows the program to make not one but several scales of grey. Suppose we have 3 scales of grey (which is the usual procedure, unless

the explanatory gap, since this would impinge god reasons for upholding the theory. But we will return to this point later.

[12] Imagine for instance that the cognitive processes in our brain would attribute shades of grey to objects in a way directly proportional to quantity of black and white they reflected. This would mean that, each time an object was in a different illumination our system would categorize it under different colours! Which would be manifestly inappropriate. It is therefore plausible to think that most animals (like most computer programs) use more sophisticated recognition processes that try to get invariants instead of a simple, direct, proportional relation.

we want to see how dogs see things). In this case any give pixel is recognised by the (normally) three numbers according to the amount of reflection it possesses for each of the three specific frequency.

It is not difficult to combine the three results directly, but this would not make a good system. This would give you a classification from one to 256^3, but this would be a bad system because none of these numbers would be correlated with a specific image property (for instance luminance, saturation, etc.) What we need is to find ways of relating the three scales that are focus on one or other aspect of the image. By using this method we can construct a system in which shades with the same luminance have more similar numbers. We can also specify that, if a pixel has the same number on the three scales (for instance 4,4,4 or 123, 123, 123) it will be categorised in the 'colourless' section.

Avoiding the use of the term 'sensation' quite clearly the problem of the infinite regression we had first posed. But it does has a cost. Notice that, ultimately, the invariant relations will be connected with firing rates and synaptic weights (just like the invariant relations of the driver are built, ultimately, from the bits send by the scanner).[13]

Now we get to the second problem of expanding the role of sensorimotor invariances to other than spatial properties. We have already said that the sensorimotor invariances, when applied to sensation, couldn't be based on sensations, now we must also concede that they can't be based on motor actions too. And this is a much more serious problem, because we easily see that the kinds of invariances we have when we analyse pictures have nothing or little to do with motor actions. Of course, in a moving organism, motor actions must be the basis of a coherent account of the world. But this has to do with the 3D perspective that we examined above. Now we are not trying to explain how we arrive at a 3D perspctive of the world, we are trying to explain things like shade or colour recognition through an invariance system. It seems pretty clear that such a system will build colour related invariances by 'playing' with different colour attributes. So the notion of sensorimotor invariances seems doubly misapplied. We should speak only of invariances, they are things we do, in the sense they are algorithms, theories, predicting mechanisms, that we, in fact, have to built. But we don't have to move our limbs or eyes to have them.

Probable objections.

From the wealth of objections these lines should provide, a few can be easily anticipated.
The first will probably be that we have given an example taken from a scanner, but one of the main points is that the retina does not operate linearly. In a scanner we can say something like, if a pixel as the number 12,12,12, then it is colorless (it's somewhere in between black and white). But nothing even remotely similar can be said of the retina. There are all sorts of distortions going on, regarding colour perception, visual acuity, etc. Added to the constant shifts motivated by saccades, it becomes obvious that a sensation of a particular patch of light

[13] Notice that this is not a trivial problem. We could thing at first sight that it would be easy to find a new correlation between motor actions and, for instance, spiking fire rate. However, notice how complicated this would be to integrate in the rest of O'Regan and Nöe's theory. In fact, one of the main advantages of the theory is that the invariances are directly connected with the world. Something that is precluded by this view. And notice also, given the importance of neural spiking, how we would be obliged to give an account of every sensation in terms of the structures of differences from sense organ to sense organ (and not from the structure of what is perceived by the organs).

cannot possibly be correlated with a specific neural activity, but must be abstracted from this activity through invariances.

I would answer, 'of course', but the problem is, these invariances are found at every level of brain processing (i.e. in levels where we know there is no associated sensation) and can be simply implemented in any kind of computer. It is just a way of categorizing information. And although saccades and head movements must be part of the equations that make up these invariants, what is specific to *image* processing, what makes red and blue more different than red and yellow, has nothing to do with motor actions. The invariances we can find there are specifically visual. I'm not denying that motor controls have a role in defining the visual objects in a scene, or in determining the compensations we must make to compensate for non-homogeneity of the visual system (just like we do in computers, any good scanner brings a driver that compensates the chromatic aberrations produced by the scanner). But it is not the *motor* system that separates the colours or that classifies the shades. At least I can't see any good argument to uphold that. The invariants are built from a different set of variables.

A second objection to our analysis is that, several experiments, specially in the area of sensory substitution, seem to have shown that subjects report that visual sensations can replace tactile sensations given an appropriate structure of sensorimotor invariances *and* motor control. This suggests both that motor control is necessary to have (visual) sensation, and that the visual character of the sensation os given by the structure of the sensorimotor invariances and not, for instance, the location at which they are processed in the brain.

Here we only partially agree (as can be expected from what we've said previously). It seems indisputable that, with probably some exceptions (as the Guppy fish), for most animals movement is necessary in order to provide any kind of meaning to a sensation. As O'Regan and Nöe point out, we can feel the wheels of the car, etc. To feel the sensation in our finger we must have had a sensorimotor experience that constructs an invariant world where the spatial location of the finger and a particular sensation go hand in hand. But, again, this is nothing more than a construction of a 3D space. All the examples given so far just show that we do have to move to associate a stimulus (or set of stimuli) to an 'outside' object. This is important, of course, but it can only show that the distal representation usually (perhaps necessarily in our species) requires the mastery over our possible movements. But distal representation does not equal visual sensation. If we want to know where is a specific object, we can ear it, smell it, (even taste it) or see it. We can even use the mechanism studied by Bach & Rita to have a clear representation of the spatial properties of the object. But, nonetheless, distal representation and visual sensation are far from being the same thing. When we ear a distant sound we also don't ear it in the tips of our ears (or anywhere else) we listened it in the room above, or in the street outside. And this does not mean we are having a visual sensation (of course). I propose the kind of experiments described by Bach & Rita should be seen in the same way, as providing a distal representation of the object (which means, among other things, they won't feel the sensation on the skin) but not a visual sensation. Of course, it would be better to try the equipment for ourselves to have a more precise opinion, but…

We should also note that what we have said above does not preclude in any way the use of invariances applied to the recognition systems in the brain. We just refrain from calling them sensations and add a few caveats regarding the role motor actions might have in forming these invariances. We would find simpler to say that these invariances are formed from specific visual attributes of the image.

4. *Philosophical side.*

Until now I have made what can only be called bad criticism, because I do not have a detailed knowledge of the matters in which I pronounced myself. Now, I will (fortunately for everybody) analyse matters much closer to my specialty, and so things should get much clearer in this part of the paper.

There is, I think, no simple argument by which O'Regan and Nöe conduct their results in psychology to form a solution to the explanatory gap. I will not, therefore, try to present the argument, which alone (even in its simplest but detailed form) would fill some pages. I will rather try to present what are undoubtedly some of the central steps of their presentation and show that some difficulties emerge.

The most obvious problem of all is that there is no obvious connection between sensorimotor invariances and first person experience. It is perfectly possible to imagine very simple systems which exhibit the relevant invariant relations and it is not at all forceful, not even much probable, not, perhaps, even plausible, to uphold that these systems possess some sort of phenomenal experience, even if it is as simple as sensation. In this aspect the traditional theory which associates brain states to phenomenal states is in a much better position because, although it is conceivable (at least for some) that someone suffering from superblindsight or zombiehood might exist, it is certainly not a plausible idea. But the consequences of accepting that invariances, by themselves, are always associated with phenomenal experience is not only mysterious, but seems unjustified and even implausible. The argument from O'Regan and Nöe does not at any moment even tries to provide a rationale for considering how or why do sensorimotor invariances produce, cause or are associated with phenomenal experience. Instead they say it is a question of definition.

Of course, nothing of this can be considered as a criticism, because O'Regan and Nöe claim that no such rationale can be given. They support themselves on Ryle's theory (and maintained today by some people like Dennett) according to which no such explanation can exist.

So, how do they argue for their theory? Well, they argue on the basis of the theoretical *consequences* of assuming the premise that sensation, recognition, awareness and consciousness are explained on the basis of sensorimotor invariances. The fact that it makes a better theory, with more explanatory power and that can make predictions unexplainable by other approaches and that are confirmed in practice (like the experience on change blindness). So, the real crux of their argument resides in these two questions: i) do they have better explanations? And ii) can't these experiments be explained based on other frameworks?

For lack of time we will not enter into these details, which would probably be the most important and interesting. Instead we will demure from these important discussions and concentrate on a completely (in our view) marginal point from the perspective of the logical structure of their argument, but which, for some reason, in the actual presentation of their ideas, gets the most prominent part. Why shall we concentrate on this? Because, it seems to us, it contains an obvious error and contributes to the non-understanding of the real positive points of O'Regan and Nöe approach.

The point has to do with Ryle's vision of the mind-body problem. This is a philosophical theory which faces several problems, it is somewhat discussed in philosophical circles but it is not, definitely, taken for granted. Now, if O'Regan and Nöe's view depend on Ryle's view than we first have to defend Ryle's view in order to defend their theory. But a defence of Ryle's point of view is certainly what is *not* done on their paper, besides, they don't even take into account the (serious) philosophical problems of this view. So, by giving a central place to a theory that is far from being generally accepted they compromise the acceptance of their theory to a less attentive reader. I say less attentive, because, on a close reading, it seems clear that Ryle's point of view, is not decisive, or even important, for O'Regan and Nöe's theory. In fact, it would make no sense to define mental properties in terms of certain type of sensorimotor invariances *because* there could be no explanation to it! Ryle's theory, in an attentive reading, proves useless to make the point and harmful to the presentation. The strength of the definition emerges from its applications, from the explanatory and predictive advantages of the theory it allows.

But why such a useless theory should appear in their argument? Well in part we think it is to respond to the point we have made above: the association between sensorimotor invariances and phenomenal experience (be it sensation, recognition or awareness) is completely mysterious. O'Regan and Nöe apparently think that appealing to Ryle's point of view can help. But of course it can't. They fail to notice the connection between their own difficulty and what they so well criticise in the 'Müller's' view of 'specific nerve energy': No one else has presented a satisfactory account of how and why a physical state, process or function should be associated with phenomenal experience! This is not a difficulty of *their* theory, it is either a general difficulty or, as Ryle would have like to say, it is simply no problem at all. In either case, the result is the same: the author's theory is in equal footing with every other theory in what regards the explanatory gap: either all of them succeed (by NOT solving the problem) either all of them fail (also by not solving the problem). This depends on either we accept or reject the ideia that the explanatory gap rests on a misunderstanding.

But whatever is our answer to *this* last problem, we hope to have showed that it makes no difference whatsoever to O'Regan and Nöe's argument. In this respect, they are exactly on the same footing as any other theory. If the sensorimotor account of perception is to be accepted, it must be because of what the old problems it solves, the new problems it gives rise, the superiority of its explanatory viewpoint. Not because of what it has similar with every other theory. And, the explanatory gap, as far as we can tell, continues as mysterious or as senseless (according to taste), as before.

Besides, by adhering to Ryle's point of view the authors engage in a peculiar risk. Suppose one day someone would indeed find a rationale for their connection between the mastery of sensorimotor invariances and phenomenal experience: the authors would then have to deny the most favourable evidence for their own theory, and that based on pure philosophical speculation! Trying to dissolve the explanatory gap (and specially with an old, independent, solution) is, as far as we can see, simply a confusion between taking hold of a philosophical perspective (perhaps for poetic reasons) and trying to defend an empirical, (and at least somewhat) testable theory.