

On the Origin of the Phenomenal

Fred Cummins

Cognitive Science Programme

University College Dublin

fred.cummins@ucd.ie

Abstract

Each of us experiences the world from a first person point of view. A proto-scientific account of this simple fact needs to establish how it is that something like a phenomenal world of subjective experience can arise at all. An account is provided of the epistemological position of a single cell, wherein the world-as-encountered is found to be a function of the structure and organization of the experiencing entity itself. There is no sense in which the phenomenal world experienced is independent of the experiencer. It is argued that this characterizes the human situation too. The role of the nervous system in bringing about an experiential world located in a phenomenal present is laid out, and some consequences for representationalist accounts of nervous system function are thereby deduced.

Introduction

A great deal of discussion has sought to interpret a presumed distinction between the "mental" and the "physical". Far less attention, it seems, has been paid to the origin of the phenomenal. By the phenomenal is meant all that which properly pertains to a first person point of view. Interestingly, it is hard to characterize that which fits this minimal definition. As interpreted here, the phenomenal is the world *as encountered in experience*. It is thus a world as seen from a specific point of view, in which space is a coordinate system centered approximately at the head of an individual, and time is likewise "centered" in a phenomenal or psychological present. A more elaborate delineation of what the phenomenal is will emerge as this article progresses, with the important caveat that a linguistic description of the phenomenal world as experienced by any one subject is quite probably not possible. Immediate experience may be intrinsically ineffable. Rather than characterizing what experience is like for any one individual, my concern here is with identifying those circumstances that may give rise to a world of experience in the first place.

I will contend here that the origin of the first person point of view can be found in the simplest form of life, a single cell. By consideration of the world as it is available to a single cell, we can begin to see how it is that a world can be encountered, or, to use the parlance of the enactivists, "brought forth". In the account developed here, the bringing forth of a world depends critically upon the availability of a specific kind of information at the boundary between the organism and its environs, and equally, upon the capacity for action of that same organism. To adopt the present view is to establish a certain continuity throughout all forms of life in sharing some necessary preconditions for experience. However, clearly, a bacterium, a pine tree and a human being, if they can be said to share any such property, do so in radically differ-

ent ways. I will therefore seek to illustrate how the nervous system may play a special role in the generation of experience, or a phenomenal world.

Some of the jargon already introduced will hopefully seem familiar to many readers, and the present story of the origin of the phenomenal can be seen as an attempt to bring together some fundamental insights of both Ecological Psychology, in the tradition of James J. Gibson (1966), and the biocentric enactive viewpoint developed originally by Humberto Maturana and Francisco Varela (1987), and later extended primarily by Evan Thompson (2007). The concerns of both traditions will recur throughout this essay.

A central feature of the present account is the claim that the perfectly familiar, phenomenal world of an individual organism is in no sense pre-given or independent of the observer. The world encountered in experience, I contend, is necessarily only to be understood with reference to the capacities for discrimination and action, and the structure and constitution, of the organism itself. This is a substantive claim, linking organism and their experienced world inextricably, in a manner quite foreign to conventional Western psychological framing.

An initial positioning of this work with respect to science is unavoidable. Science, almost by definition, seeks to describe that which is "objective", and to peel away the flesh of the subjective, which is synonymous with untrustworthy. By excluding the subjective in this radical manner, no obvious route remains by which one could talk coherently of the first person point of view, or the phenomenal. Indeed, the phenomenological tradition of continental philosophy has long had a somewhat strained relationship with science (with some possible exceptions, such as the work of Maurice Merleau-Ponty).

Yet science seeks to establish consensus. To do so, it is necessary to develop a language that includes not only gravity and the fundamental forces of physics, but that admits of the reality of the subjective phenomenal world of experience. Here, I will present a way of framing the discussion around the presence of the phenomenal world of experience. My account is intended to be a scientific contribution, but to also suggest that science itself needs to grow just a little bit, to include the reality of experience in its collective understanding and theories. Alternatively, this contribution can be readily viewed as one formulation of a claim heard from several quarters: that of the non-reducibility of biology to the explanatory framework of physics. The fundamental divide is not between the mental and the physical. There is a fundamental divide, but it is between the living and the inanimate, for it is life that introduces the conditions for the generation of experience.

In what follows, much use will be made of a simplified caricature of the epistemological position of a single cell moving freely in a medium. This skeletal example will provide a useful starting point for consideration of the relation between the organizational unity that constitutes a living entity and its (appropriately defined) environment. A functional relation between information and movement, or between perception and action (taking some liberty with those over-loaded terms) will be established as the starting point for adopting a point of view with respect to the world, and thus for the origin of the subjective. The role of the perception/action relation for the simple cell will be drawn as continuous with its role in multicellular organisms.

In traversing the vast evolutionary path from prokaryotic cell to human, few fundamental innovations arise, but one of these that merits special consideration is the

introduction of nervous systems into the organism, and the special role that nervous systems play in bring about a more elaborate perception/action relation. It will be argued that nervous systems introduce a huge degree of mediation between sensory information and attendant action, and, crucially, this mediation embeds the phenomenal experiential world of the organism in time, generating the psychological present, and therewith the foundation for the development of concepts, categories and all the shared elements of a socially constituted reality.

The Epistemological Position of a Single Cell

A single cell may seem like an odd place to start in an account of the nature and origin of human experience. The gap from one to the other may, at first blush, appear so enormous as to render any account of continuity of experience meaningless. In debating the nature of cognition, there has been little or no agreement as to whether cognition should be regarded as something exclusively human, or as continuous with the abilities of the great apes, or with primates more generally, or with mammals. Some have gone so far as to characterize the behavior of groups of bacteria as exhibiting the hallmarks of cognition (Van Duijn et al., 2006), and the idea that plants might be considered cognitive has been raised (Calvo and Keijzer, 2009). Clearly, the most substantive disagreements here lie, not in the recording of facts about the observed behavior of other species, but rather in construing the nature of cognition, and the vocabulary of the mental that is used to interpret those behaviors. This vocabulary includes notions of agency, intention, and will (Dennett, 1987; Ryle, 1949).

Instead of asking about cognition, (or minds, qualia, or consciousness) and thus setting ourselves up for yet another contribution to that vexed debate, one might sensibly restrict one's attention initially to the origin of a subjective point of view.

There is a sense in which both a human being and a single cell can be said to have a subjective point of view, without necessitating the ascription of any kind of experiential qualities to the cell (or, indeed, the human). A subjective point of view demands a privileged point in space and time from which the world is met in experience, but more than that, it demands that the world be uncovered *as it appears to a specific kind of entity*. We thus start with a simple model entity, the cell.

A cell is recognizable as a unified entity, distinct from its surrounds. Its distinctness is clearly demarcated by its membrane. The functional realm of cell metabolism constitutes a domain of organization that is autonomous. That is to say, we can clearly distinguish between those processes and interactions that are cell-internal, and those that involve interaction with the environment. A cell maintains its own integrity in the presence of environmental flux. Its encounters with its environs are meaningful in as much as they affect this essential characteristic. It thus meets its environment with concern, in a way that an inanimate object does not. In an objective sense, a cell can therefore be regarded as having a subjective point of view, without insisting that there is anything that it is like (to use the overly familiar jargon of recent philosophy) to be the cell. For now, this claim of a "subjective point of view" means that interactions between cell and environs are meaningful for the cell precisely as they relate to the autonomous and precarious functional organization that exists within the membrane. Such interactions are not meaningful in any pre-given, cell-independent, sense, and the cell does not have any disinterested apparatus with which to evaluate those features of its environs that impinge upon it. Rather, interactions will affect the cell in a way that is determined by the details of the complex inner dynamical organization of the cell itself. By the same token, this account does not yet suggest how a phenomenal world might arise for the cell. But we proceed one step at a time.

We might note that interactions between cell and environment are best described with reference to a spatial coordinate system centered at the interior of the cell, and in a timeframe matched to the metabolic processes that take place within the cell.

For the present purposes, a simplified notion of a single cell will be employed. This caricature is deliberately drawn in a way that will allow the interaction between cell and its external neighborhood to be considered, without many of the complications that pertain to a fuller, more realistic, model of cell behavior. Indeed, prokaryotic cells, although simple in some sense, exhibit an impressive range of behaviors, singly and especially in groups, that include complex signaling, mimicry, cooperation, etc (Lyon and Keijzer, 2007; Van Duijn et al. 2006). Instead, we will consider an idealized cell in a medium containing a single nutrient substance located at some distance, and giving rise to a nutrient gradient between cell and source. The account of the relation between cell, environment and gradient is, however, based on the real mechanism of chemotaxis, and has been used as a paradigmatic example of a living agent by several authors (Thompson, 2007; Lyon and Keijzer, 2007; Varela, 1997). This scaled-down account is based directly on Van Duijn et al. (2006).

The cell is at some remove from a nutrient source. Nutrient concentration decreases in proportion to distance from the source. If the gradient can be detected, it will provide sufficient information to specify the approximate direction of the source. To detect a gradient, the concentration at two distinct locations needs to be sampled. Our token cell is, however, too small that it could sample from two distinct locations on its membrane and deduce the gradient from that. Rather, it needs to sample the concentration in several places by moving around. It is provided with

a set of flagellae, or whip-like appendages that can be used to move in two quite distinct ways. Firstly, the flagellae can move more or less randomly. The resulting motion of the cell is, of course, essentially random as a result. Alternatively, the flagellae may move together in coordinated fashion, producing motion in a straight line. These two mechanisms work together in a very simple fashion. The cell simply switches randomly from one behavior to the other, but the probability of switching from coordinated movement to random movement goes down as the concentration of the nutrient goes up, and vice versa. Thus, if, by chance, the cell is doing fairly well, it is likely to stay on its present course. If, on the other hand, the nutrient signal is weak or weakening, the cell is likely to change course, and so, on balance, the cell will progress towards the nutrient, without any need for complex control mechanisms at all. This mechanism works admirably in a stochastic environment, in which nutrient sources may be transitory and non-stationary.

It may seem hyperbolic to talk of perception and action in the case of this simple cell. When we talk of perception, we often think of the identification of objects and events around us, together with their categories. So we happily say that we perceive a table, or a car crash, both of which presuppose considerable capacity for categorization, and for the interpretation of experience in a conventional manner. (Note that we could conceive of a human whose cultural background was such that what we see as a table was not clearly perceived in this role, that is, as something at which we sit, from which we eat, etc.). None of this is available to our cell. Likewise, pre-theoretic notions of action typically involve some element of agency that we might be reluctant to ascribe to the cell, and we certainly do not want to impute goals or strategic planning to our simple cell.

However, the bedrock of all these sophisticated abilities that we so value in our selves, lies in the existence of a lawful relation between movement and the detection of change on the sensory surfaces. This we share with the cell. There is a large body of experimental work that seeks to explicate this lawfulness. It does not treat perception as sensory input which is processed and gives rise to motor output. Rather, it sees perception and action as intimately and directly related. A graphic illustration of this close lawful relation even in humans can be seen in the swaying room paradigm of Lishman and Lee (1973). In their experiments, a room mounted on wheels was used, so that it could be moved gently back and forth. This movement produces a regular pattern of change upon the retina of a person standing in the room; this structured pattern of change is known as optic flow and is the informational basis for much of our interpretation of motion in our environment. For the subject in the swaying room, there is a concomitant postural adjustment, because the optic flow induced by the swaying of the room would, under more normal circumstances, specify a falling-forward and a leaning-back. The pattern of change on the retina would normally be reliably associated with a swaying torso, rather than a swaying room. Optic flow has this ambiguity to it, in that it says that there is motion, but it does not say who is moving. The pattern of change as you approach a wall is the same as that generated when the wall approaches you. So as the room sways, the body produces a corrective action as if it were the source of the pattern. In the data, we see tightly locked oscillations of room and torso, bound together by the structured change in light and dark on the retina. Room and person are bound tightly and lawfully. This is the kind of lawfulness we share with the cell. Structured pattern of change on the sensory surface (membrane, for the cell) stands in lawful correspondence to the movement of the organism. Movement generates change on the sensory surfaces, and change on the sensory surfaces produces movement.

The relation between the changing sensory patterns and the attendant motion is particularly transparent and direct in both the cell example and in the person locked in anti-synchrony with the swaying room. We would recoil at any suggestion that our willful actions, those acts we choose to commit, stood in any similarly lawful relation to the changing flux on our retinae, in our inner ears, over our skin. There is little chance of a skilled scientist of perception being able to demonstrate that my choice to go to see a particular movie was bound in a lawful relation to the patterns my environment generated upon my sensory surfaces. The perception-action link being described here is at a much lower level, in which energetic flux on receptor surfaces and attendant motion are lawfully related.

Much of the study of perception has made the basic mistake of taking the pattern of stimulation at the sensory surfaces as a noisy signal that acts as input to a deductive mechanism that in turn extracts information from the signal+noise composite about the world "outside". The singular contribution of the discipline of ecological psychology has programmatically avoided this tactic, and has looked instead at the organism-specific kind of information that is directly available at the sensory surfaces, without any further computation. This is not information in any objective sense, but rather it specifies the relation between the organism, the movements of the organism, and the properties of the ambient surround as relevant for the movement of the organism. In a fashion entirely analogous to the predicament of the cell, our sensory surfaces are the locus at which we most clearly see the lawful relation of organism and environment. They are not input devices. They are rather a boundary, at which variation in the external surround, and movement of the autonomous organism are lawfully related.

The claim to be offered herein, is that the phenomenal world of subjective experience arises as an elaboration of this relation between perception and action¹. "Perception" here does not mean recognizing tables and chairs. That is a derivative phenomenon. It means the pattern of physical and chemical change at the exterior of the organism that is lawfully related to the motions of that organism. Likewise, "action" means change in the relation between organism and environment. In simple organisms, and in very specific cases for complex organisms, we can see the direct relation between perception and action so considered.

The perception/action relation outlined in the above case of the simplified cell can hardly be said to give rise to a phenomenal world. Perhaps we might stretch empathy to its absolute limits and imagine a world in which phenomenal space begins to arise as one direction is distinguished from another by the existence of the gradient. But we cannot conceive of a full phenomenal world without introducing a distinction between subject and object, and the direct relation between the gradient and the action of the cell do not warrant any such separation. We would therefore have to regard this differentiation of phenomenal space, not as something perceived, but as both that which is perceived (part of the world, object, other) and as the direction of motion (acting on the world, subject, self). Perhaps it is better to abandon the attempt at empathy and admit that there is nothing that it is like for us to be a cell.

I have described the changing flux expressed at the membrane of the cell as “information”, and it is important that this term be further described, because there are many competing notions of information, and not all of them will serve our purposes here. In as much as the pattern of change at the membrane is capable of affecting the internal workings of the cell, it might be considered meaningful to the cell. The nutrient gradient is meaningful, precisely because of the role of the nutrient in the cell’s metabolism. It has no intrinsic meaningfulness that makes sense without simultaneous consideration of the properties and constitution of the cell. It is thus meaningful and informative for the cell. In some recent writing within the enactivist tradition, the term used would be “value” or “meaning” rather than “information”, but the point is essentially the same (Di Paolo, 2005). The gradient is not meaningful in any cell-independent way. Extrapolating from this example, we can claim then that the world as encountered by the cell is drawn in terms defined by the cell’s own nature. The world revealed to the cell is a function of the kind of being that the cell is².

This generalizes to the principal substantial claim of the present thesis:

The world encountered by an organism is not independent of the structure and constitution of the organism itself.

² As external observers, we can see many things about the cell’s situation that it is oblivious to. We might note, for example, that there are many other chemicals in its surrounding solution that have no biological significance to the cell, that are not detected, and that they, therefore, can not be considered to be part of the world experienced by the cell in any sense whatsoever. Likewise, in our physical environment, we are constantly bathed in energetic flows we do not register: radio waves containing broadcasts from around the world, microwaves, ultraviolet waves, lap over us and permeate our bodies without leaving the slightest trace. They are as much part of our environment as the patterns of visible light we rely on so critically, but they give rise to no phenomena. They thus fail to show up in our phenomenal worlds.

Difficulties in providing an account of the phenomenal realm

An important corollary of this claim is that *the epistemological predicament of the cell is not different, in principle, from that of a human being*. The origin of the phenomenal realm in each case can be traced to the way in which the organism is embedded in its environment, and the lawfulness of what we are here calling the perception/action relation. But this claim depends upon a recognition of the phenomenal as a well-formed domain. This is not as straightforward as might perhaps be expected. The phenomenal realm, it must be remembered is the world as encountered in experience. It is not something to be uncovered in the world; it is that which gives you or me a world in the first place. Your phenomenal realm does not include that table, but that-table-from-your-point-of-view-as-seen-and-felt-and-experienced-by-you. It also includes your direct experience of your self as you appear as a thing in the world.

There are probably several reasons why it is difficult to discuss the phenomenal realm coherently, despite the obvious fact that the phenomenal is, by definition, that which is readily available and immediately present for each subject individually. There may be more than these two, but there are at least these:

Firstly, language is not a great tool for talking about that which is peculiarly subjective, for the simple reason that language serves to facilitate the alignment of experience and the coordination of behavior *across* individuals. It is intersubjective in its very nature, as is required for something that serves to allow one autonomous realm of experience (your phenomenal realm) to align with another (mine). This brings difficulties in talking about the subjective realm of experience, and attending to that which distinguishes one realm from another.

Secondly, our worlds of experience are deeply embedded in time. Experience for a human is not the instantaneous relation between sensory stimulation and self-motion. Our experiential worlds are far richer, temporally extended, and include a background presumption of a distinction between self and surround. In discussing the role of the nervous system in the generation of a phenomenal realm, this will be elaborated upon at length. But for the present argument, it is sufficient to note that most of us (all?) have considerable difficulty in attending directly to that which is sensorially present at any given moment. Mindfulness and meditative techniques attempt to train the subject to attend to present experience, with differing degrees of success, but for most of us, most of the time, our experience is not limited to the immediate relation between perception and action; our attention wanders, our experience drifts between recollection and projection, imagination and recreation, all of which is at some remove from our immediate physical surrounds and our own movements therein. This mind-wandering, we have come to regard as private, or interior, and we distinguish that from an exterior, shared world. However, all aspects of experience are private: the red car you see, you see from a privileged position that is distinct from the position I see the car from. We can talk about a common, shared, car quite readily, as our respective experiences of the car will be founded upon entirely lawful relations between energetic distributions at sensory surfaces, and own movement. This lawfulness ensures that our experiences will be quite similar. My Proustian recollections of childhood summers are not grounded in any such lawful relation and they are thus less readily communicable.

These two considerations suggest that there is, and must be, an idiosyncratic, incommunicable residual to experience that makes *my* experience ineffably different from *your* experience. There is no straightforward way to quantify this difference.

And neither is divisible into interior and exterior. My experience of the red car and my experience of imagining last Summer are both simply part of my phenomenal realm, and neither one is inside anything! The linguistic habit of referring to some aspects of experience as interior and others as exterior is hard to shake.

Beyond the single cell

I have argued that the origins of the phenomenal are to be found in the concerned situation with which an organism encounters a world. This was illustrated using a simple cellular example, with the brash claim that the relation between the organism and its world of experience is not different in principle for a human being. But there are enormous differences, I hope, in the nature of experience. I am entirely unwilling to ascribe any of a host of mental predicates to a cell, or to attribute subjective experience to it in anything other than a formal, structural form as outlined above.

There is a long phylogenetic chain from prokaryotic cell to human. We must first pass from single-celled life forms to multicellular beings. Then, somewhere still at great remove from our present form, nervous systems appear on the scene. These two innovations seem at first blush to threaten any continuous account of the origin of the phenomenal that can span the entire range of life.

Multicellular beings need not detain us much further. As life forms, they constitute a domain of organizational closure just as the cell does. Where the cell has a single membrane, a multicellular being may have a skin made of cells, or an elaborate armor made of chitin, or any of a number of kinds of boundary. The role of this boundary is directly comparable to the role of the membrane in the cell, and just as

passage across the membrane is tightly regulated in accordance with the metabolic needs of the cell, so passage across the external boundary is tightly regulated by any such composite being. Any influence of the environment on the internal dynamics of the organism are based on local perturbations or energetic patterning at some part of this external boundary. For a multicellular being, some parts of the boundary may exhibit specific sensitivities to the local energetic flux, rather than the undifferentiated distribution of sensitivity across the entire cell membrane. These are retinas, basilar membranes, and the like. But at all parts of the boundary, there is a lawful relation between the physical/chemical/energetic flux at the boundary and the motions of the organism. Furthermore, the organism will be sensitive to just those fluctuations that bear relevance for its sustained viability as a living organism. It will meet a world drawn in terms of its own constitution.

One simple example may serve to illustrate that in a simple multi-celled animal, the nature of the relation between perception and action (defined as above) is just as direct as it was in the cellular case. Perhaps the simplest visual system yet documented belongs to the box jellyfish larva (Nordström et al., 2003). The entire animal has only 5 differentiated cell types, three of which are found in the membrane. Most membrane cells have single ciliae, or hair-like appendages, which vibrate in uncontrolled fashion, producing an undirected force. Interspersed throughout the membrane we also find a second type of cell which is photo-sensitive, and the action of the light within the cell causes its cilia to adopt a specific angle with respect to the light gradient. (The third type of membrane cell is irrelevant in the present context.) Collectively, these photo-sensitive cells with their ciliae act as a distributed rudder, steering the otherwise uncontrolled motion of the larva with respect to the light gradient. Again, perception and action are directly, inextricably, and reciprocally, linked. They constitute a single functional relation, and they serve to exploit

lawful properties of the environment that are matched to the constitution of the organism.

The role of the nervous system

Nervous systems introduce a more dramatic and important change in the way that the perception/action relation is manifested in the service of maintaining the functional organization of an organism. There are three principal ways that nervous systems alter this relation.

The first consequence of having a nervous system is that information (as described above) that is realized at one point on the sensory surface separating organism and environment may be related to a motor "effect" at a distal part of the organism. Nerves are rapid conduits, allowing information (properly interpreted) to move very rapidly. This in turn allows larger and more complex forms of bodies to evolve, often with specialized appendages whose sole function is to register this kind of information. This, in turn, opens up a huge space of potential designs for evolution to tinker with, that would otherwise be inaccessible to organisms reliant on chemical diffusion alone for linking sensory information and motion.

(Before progressing, a caveat is in order. In the above, I have been at some pains to treat of the perception/action relation without privileging either one as cause and the other as effect. Our conventional, information processing metaphors for understanding nervous system activity insist on regarding sensory modalities as input channels and motor activity as a resultant effect. The view presented here views all activity of an organism as generating lawful changes in the flux of information at the sensory surfaces, just as that flux generates action. Neither is privileged. Once

we discuss the properties of nervous systems, this lawfulness becomes harder to see, and it is quite easy to revert to established metaphors of information processing. Once that is done, and sensory information is now treated as input, it is virtually impossible to avoid the presumption of agency and autonomy in the organism, and to see its action as divorced from the organism-environment relation. As we progress from the bedrock of a direct relationship between sensory flux and attendant motion, towards the familiar concepts of everyday experience, linguistic conventions force themselves upon us, and the conventional metaphors of inner and outer realms, and the attendant notion of free agency, can not be completely avoided.)

The second consequence of nervous system organization is that the nature of the relation between sensory information and the associated motor activity becomes vastly more complex. If we consider either sensory information or activity of the organism as input and the other as output, multiple "inputs" can be combined and those inputs can be combined non-linearly. This allows non-additive combination of inputs, shunting, gating, reverberation, and any of a host of other dynamical phenomena that now can come to occupy the functional territory between the energetic gradients at the receptor surfaces, and the attendant motion of the organism. The functional relationship between sensory information and movement becomes opaque and smeared in time, which leads to the third large innovation that arises with nervous systems: the functional relation between sensory information and motion becomes deeply embedded in time. The embedding in time seems to be absolutely necessary for the kind of subjective experience familiar to all of us. As is well known, that which we conveniently call the present moment is not, and can not be, punctate. Rather, our worlds of experience have a complex relationship to clock time. Stimuli experienced "in the present" may be smeared out over approximately

two seconds, though no sharp boundary has yet been successfully proposed. Our world of experience is also hugely removed from the direct energetic play at the receptor surfaces and our immediate movement. We spend large parts of our lives mentally time-traveling, imagining, reminiscing, and, Walter Mitty-like, creating life narratives that never were or will be.

So nervous systems change the game greatly, but not fundamentally. They do not alter the epistemological predicament of an organism embedded in a complex environment, that couples with that environment through the lawful relation that obtains between energetic flux at the boundary, and attendant motion. This is the position of a single cell and it is the position of a human.

Beyond the merely phenomenal

As humans, we do not encounter a world naively. Beyond the merely phenomenal world we encounter through our bodies, there is a baroque conceptual superstructure we inherit as our birthright as enculturated individuals. We can not but see the world through the categories and abstractions that structure our altogether human lives. We can not see a word without reading it, nor look at a television screen as a flat surface of dancing lights. The smell of mulled wine will necessarily put us in a Christmas mood, be that good or bad. This additional richness to our embedding in the world goes beyond the biological. Received ways of interpreting the world, conventions of attitude and understanding, are deeply ingrained, so that we can no longer separate our experience of a physical world from our experience of a world structured by other humans.

One part of this conceptual baggage many of us inherit is the notion of an autonomous agentive individual, separated and entirely distinct from his Umwelt, or surrounding world. This is the fictive atom of psychology: a person who is distinct from the world he meets. But it is a fiction, and a cultural myth. Each of us encounters a world in the first person, and that world is not pre-given and independent of the experiencer. Its spatial and time scales are determined by the spatial and timescales at which the organism exists. The romantic notion of standing under the night sky and being humbled by the vastness of space is predicated upon the fallacy of an independent spatial metric with 'big' at one end and 'small' at the other. But the only meaningful scale of reference that can sustain such quaint notions is the spatial scale of the observer. Likewise, we conventionally talk about events as ordered on an observer-independent time scale (though we know better in theory). But the notions of 'quick' and 'slow' are again meaningful only to an organism with a characteristic timescale. We use the tricks of time-lapse and high-speed photography to pull events in to the phenomenal realm, just as we use microscopes and telescopes to drag 'things' into the world of direct visual experience.

It is worth noting in passing that the environment of which we here speak is restricted to the physical environment only for entirely asocial forms of life. For all others, including both real bacteria and real humans, meaningful encounters with con-specifics are at least as important to the survival of the organism as encounters with tabletops and rocks, and so the environment must be understood as both social and physical.

Recognizing that the world encountered in immediate experience by an individual is not independent of the structure and function of an individual has direct and important consequences for our expectations from neuroscience. Many approaches to

neuroscience take the theoretical constructs of psychology as given, and seek to interpret neural activity in those terms. In particular, the notion is widespread that nervous systems are involved in interpreting noisy signals from an external world, and generating representations thereof, so that the objects and events we encounter are mirrored in the systematic activity of nerve cell firings. The present account suggests that this approach may miss something fundamental about the fit between the phenomenal world of experience and the activity of the body, including its nervous system. A metaphor might help here.

A humming bird's beak is exquisitely matched to the shape of the trumpet of a specific flower. The flower's shape, in turn, is a perfect fit to the bird's beak. Both are the product of a long process of co-evolution. Nobody would be tempted to describe this state of affairs by saying that the beak represents the flower, or vice versa. A long history of co-evolution has produced a matching pair in beak and trumpet. This state of affairs seems to parallel the relationship between nervous system (beak) activity and the phenomenal world (trumpet) very well. Furthermore, the beak viewed independently of the rest of the bird (body) is virtually uninterpretable. Nervous system activity, by the current account, gives rise to a meaningful phenomenal world as it mediates the relation between sensation and movement (correctly understood). When we rigidly control the physical and social environment of a laboratory subject, and study their behaviour directly or indirectly, it is much as if we were to try to understand the beak of the hummingbird through studies that employed a flat, rigid plastic feeder, for which we could meticulously control rigidity, size, liquid consistency etc. It is not that we could learn nothing about beaks by this activity, but we would surely miss many important aspects thereof, and fail to arrive at a complete picture of the beak and its natural match.

References

Calvo, P. and F. Keijzer (2009), Cognition in plants. *Plant-Environment Interactions*, pp. 247-266, Springer Press, Berlin, Heidelberg.

Dennett, D. C. (1987), *The Intentional Stance*, MIT Press, Cambridge, MA.

Di Paolo, E. (2005), Autopoiesis, adaptivity, teleology, agency. *Phenomenology and the Cognitive Sciences*, 4: 429-452.

Gibson, J. J. (1966), *The Senses Considered as Perceptual Systems*, Oxford, England: Houghton Mifflin.

Lishman, J. R. and D. N. Lee (1973), The autonomy of visual kinaesthesia. *Perception*, v. 2(3), pp. 287-294.

Lyon, P. and F. Keijzer (2007), The human stain: Why cognitivism can't tell us what cognition is & what it does. In *The Mind, The World, and The Body: Psychology After Cognitivism*, ed. B. Wallace, Throverton, UK: Imprint Academic, pp. 132-165.

Maturana, H. R. and F. J. Varela (1987), *The Tree of Knowledge*, New Science Library: Distributed in the U.S. by Random House, Boston.

K. Nordström, R. Wallén, J. Seymour, and D. Nilsson (2003), A simple visual system without neurons in jellyfish larvae. *Proceedings. Biological sciences / The Royal Society*, v. 270(1531), pp. 2349-2354.

Ryle, G. (1949), *The Concept of Mind*, Oxford, England: Barnes and Noble.

Thompson, E. (2007), *Mind in Life: Biology, Phenomenology, and the Sciences of Mind*, Belknap Press.

Van Duijn, M., F. Keijzer and D. Franken (2006), Principles of minimal cognition: Casting cognition as sensorimotor coordination. *Adaptive Behavior - Animals, Animals, Software Agents, Robots, Adaptive Systems*, v. 14(2), pp. 157-170.

Varela, F. J. (1997), Patterns of life: Intertwining identity and cognition. *Brain and Cognition*, 34: 72-87.