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The Perceptual Form of Life

To view organismic functioning in terms of integration is a mistake, although the concept has dominated scientific thinking this century. The operative concept for interpreting the organism proposed here is that of articulation or decomposition rather than that of composition from segregated parts. It is asserted that holism is the fundamental state of all phenomena, including organisms. The impact of this changed perspective on perceptual theorizing is profound. Rather than viewing it as a process resulting from internal integration of isolated features detected by receptor neurons into a perceptual whole, the new theory suggests that the task of perceptual processing is to breakup what initially exists holistically in sense organs into features and eventually perceived objects. Similarly, the goal of perceptual activity is not Sherrington's, that of integrating essentially unrelated organisms with their environmental surround, but rather to generate percepts in which the environment appears as a field of objects and events independent of the perceiver which are available for manipulation. Perception is a process by which organisms use their embeddedness in physical reality as if they were independent of it. There are a number of interesting results of this conceptual reorientation. The binding problem is eliminated because the percept's holistic character is the precondition for neural activity, not its product. The concept of representation can be dispensed with since the fundamental conceptual motivation for its introduction – the assumed need to produce an internal copy of what was assumed to exist independently outside the organism in order to integrate organismic behaviour with its environmental causes – is rejected outright. And finally, the issue of perceptual consciousness is addressed: how does the percept acquire its objective status vis-à-vis a perceiver, and what is the basis of the experiential character of perception?

The real task today for those critical of cognitivism is to develop viable theoretical alternatives to such models. Perceptual theorists, for example, ought to ask what form a truly nonrepresentation-based perceptual theory might take and how might it reinterpret the data gathered by perceptual system researchers over the past half-century? I have developed one such theory whose basic propositions are summarized in the present paper.

By way of introduction, the new theory represents a profound rethinking of the perceptual problematic. Of course, the proposed theory makes no use of the concept of representation, hence it is non-cognitivist in spirit. It also rejects the naïve realism of representational theories because it does not equate what is perceived by the organism with the physical causes or stimuli that give rise to perception. This means that the new model does not 'perceptualize' the physical stimuli such as light or sound waves transforming them into colour or sound that is assumed to exist before perception takes place. All *perceived* features and objects are the *products,* not the causes, of perceptual processing. The nature of physical reality prior to perception is not that of the perceptual unities (objects and their features) of percept, and cannot merely be copied by perceptual systems. But rejection of naïve realism does not imply that the current theory is a form of subjectivism, for it does not claim that the percept is merely subjective. Subjectivism violates the principle fundamental to the new model, that all phenomena (whether physical or mental) are inexorably embedded in a causal network of reality. The notion of a cut off or private (acausal) interiority is essentially meaningless. The new model attempts to walk a middle road between the extremes of naïve realism which underpins cognitivism's representation-based theory of perception and the dead end of a meaningless subjectivism which too often is assumed to be the only theoretical alternative when representational thinking is abandoned.

Two premises form the basis of the new model. They are set in opposition to two of the fundamental assumptions of cognitivist theories of perception: that the aim of perceptual functioning is to produce a copy (internal representation or correlate) of what is thought to exist independently outside the perceiver, and thus to co-ordinate or integrate what goes on within the perceiving organism with its external environment. The two counterpremises proposed by the new model are that (1) what is perceived, the percept[1], cannot be copied from the so-called stimulus array because the contents of the percept (perceived objects and features) are not 'out there' simply waiting to be detected and copied. The percept is uniquely perceptual in nature; it is the product (not the physical cause) of perceptual system functioning. And what is more, (2) the new model proposes to view integration of the organism and its environment as a *given.* It is not the task of perception to integrate the organism with the rest of the physical world. The view of the organism as an isolated or essentially unrelated physical system is a fiction, a theoretical construct that ought to be rejected if we are to achieve a more satisfactory account of organismic functioning.

Regarding the issue of integration, if one views the relation between what occurs within the organism and the environmental surround as essentially integrated from the start, this rules out the existence of an independent or isolated internal sphere of reality that is presupposed by subjectivist accounts. Nothing takes place within the organism that is not always already related to what goes on outside of its skin. Nor, it should be added, are internal organismic processes correctly viewed as inherently independent. The holism of the new model applies across the board to all aspects of organismic functioning, internal and external. Yet, historically the view of integration as the goal of organismic functioning, as a product of compilation, is the operative concept in terms of which organisms have been understood at least since the time of Sherrington (1906). It is traditional to view the organism as a collection of parts, each of which serve individual functions that are welded together by nervous system functioning to produce the global

[1] By 'percept', I mean the object, state of affairs or event that is perceived. So all directly experienced objects are percepts, i.e. objects that are not merely imagined, remembered, etc. In the language of philosophy, a percept is the intentional object or objective correlate that stands in relation to a perceiver by any act of perception. Percepts can be conscious or unconscious. Awareness or the direct experience of them does not create the objective status of their content, i.e., awareness is not itself objectifying. In the present paper, however, I restrict the discussion to conscious acts of perception. My interest is not in what makes a percept conscious, but rather in what it is about organismic functioning that contributes to the creation of the percept.

behaviour of the organism. Perception's function, given this interpretation, is to integrate what goes on inside the organism with what goes on outside, as if the two spheres were fundamentally unrelated in spite of their obvious causal interaction.[2] Moreover, mind, according to this conceptual scheme, is just another isolated component standing in need of integration, this time with the physical realm. Thus, it is not surprising that Sherrington's ultimate goal was to discover the final integration which unites the 'two great, and in some respects counterpart, systems of the organism' – the physical body and the mind. The new model proposes instead that we think of holism as the initial condition of all phenomena and of parts as produced. This is the conceptual inversion that is applied here to interpret organismc functioning.

Yet if holism is the initial condition of everything that exists, then the entire landscape for perceptual theorizing changes drastically. The new model proposes that the real problem of perception is that of *articulation*.[3] The goal of perceptual functioning is to break up the holistic fabric of reality into perceived objects and states of affairs and perceivers of them. Thus, the perceptual problematic is inverted from that of integration to a situation in which perceivers generate percepts in which the world appears to the perceiver as a collection of objects and events independent of the observer which are available for manipulation. Perception is a process in which perceivers use the seamless state of their embeddedness in physical reality as if they were independent of it by creating percepts.

The new model's view on the question of integration also has implications for the first of cognitivism's fundamental assumptions, the idea that perceptual systems internalize copies of the extra-organismic environment. Cognitivist theories require a copy of the external stimulus because they assume what goes on inside the organism is essentially cut off from what occurs outside its skin. Internal representations form the 'glue' to integrate the two spheres. However, having rejected all talk about genuine independence, indeed of gaps in physical reality, the new model has no need for internal copies, images, or maps. While the new model accepts that the extra-organismic environment is indeed 'structured' and that it therefore shapes and constrains organismic functioning, it claims that the effects of such processes are accomplished without creating internal representations. Perception is a complex set of processes interpreted as 'uses' that progressively articulate the interactive organismic events taking place at the interactive interface between the organism and its environment into percepts.[4] The organism and its

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[2] The conceptual conflict inherent in viewing organismic functioning as both the product of causal interaction with external stimuli and in need of reintegration with the external world pervades contemporary thinking in science, philosophy, cognitive science and psychology, producing many of the problems that bedevil theorists today as in the past. Logically speaking, there are only two possibilities. Either something is related or it is not. If it is related, it does not stand in need of relating and hence the question of integration is moot. If its nature is to be unrelated, then unrelated it will remain. According to the present model, what exists (that which is real, reality) is by nature related. To be subject to causation, I hasten to add, is to be related from the start. Causation does not create relations among unrelated phenomena. It is a particular kind of relationship of influence holding between already related phenomena.

[3] 'Articulate' here is used in its Latin sense of articulatis, i.e., something divided into components, or jointed as a limb is jointed. Thus I describe a process of articulation as that of 'shattering', a process of deconstruction

[4] Strictly speaking, an environment is the product of perceptual system functioning, not its precursor. That is to say, prior to perceptual functioning that defines for the organism what counts as 'self' and what is 'not self' or extra-organismic, what occurs 'within' is just as 'external' as any other physical process occurring in the physical world. It is organismic functioning itself that establishes the distinction. In other words, the

world are always already integrated and the articulation of them into correlated spheres of functioning does not and cannot remove the relatedness. The prior integration of percepts with their physical causes is implicit in every facet of their articulation.

There is a conceptual distinction essential to the proposed new model's rejection of representation-based theory that cognitivism fails to recognize. The distinction is that between physical reality and perceived reality. By physical reality, I mean the pre-perceptual, physical bases of perception, its raw material. Perceptual reality, on the other hand, refers exclusively to the percept, to that which the perceiver perceives. So, with respect to perceptual system functioning, 'physical reality' refers to things like light or sound waves and neural activity, while 'perceptual reality' refers to the product of perceptual functioning, i.e., the percept.

There is a substantial and convincing body of scientific research to support this distinction. It has been demonstrated, for example, that perceived features are unique to the percept. In the field of visual research, for example Helson (1938) and Land (1977) demonstrated that perceived colour has no counterpart in the physical phenomena with which the eyes interact (see also Gibson, 1979). Light and its physical properties are not colours. Colour is generated first by so-called opponent mechanisms that are part of the visual system and which contrast different wavelengths of light to produce perceived colours. Moreover, there is not even a strict correspondence between a given wavelength of light and the colour perceived, as one might expect given representation-based thinking. For example, humans perceive the colour green when more middle-wave light is reflected from the stimulus array, but an object can be perceived as green even when the array, in fact, reflects more short-or long-wave light. And it has also been shown that the very same wavelength of light can be perceived as different colours depending on the context in which it occurs (see also Gurwitsch, 1964). Finally, there are findings that indicate that objects themselves are uniquely perceptual phenomena. Gouras and Zenner (1981) concluded from their research that it is impossible to separate the object perceived from colour because colour contrast itself forms the object. Thus, even objects are essentially perceptual phenomena since colour is a property of percepts, not of the physical stimulus array. Perceived features, not the external stimuli, help to create visually perceived objects.

All of which means that somehow a shift is made from the pre-perceptual, physical reality to the percept, but it is wrong to further equate this transformation with an abrupt break that isolates the percept from the pre-perceptual bases of perceptual functioning. The percept is inextricably embedded in the causal web of physical reality, which means that constraints always operate on the percept from its causal antecedents. The physical stimuli operate as a set of boundary conditions upon the percept. Somehow the percept and its contents are created with an apparent (perceived) independence from the observer while the percept itself and the perceiving organism remain embedded in physical reality. Explain this, and we will have gone a long way towards understanding perceptual functioning.

Proposition One *The first product of perceptual system functioning is the 'phenomenal fabric' of the percept that is created by the sense organs.*

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organism-environment contrast is not a fact about the world; it is a fact created by organismic functioning itself.

The new model's first proposal, then, is that the sense organs make *direct contributions to the percept* that are not, and need not be, filtered through neurons. Thus the new model rejects neurocentrism, the view that neural activity alone contributes to the percept, a view that has already come in for criticism (Damasio, 1994). But the real problem with neurocentrism in relation to perceptual theory, as I see it, is not just its preoccupation with neurons, but the fact that it leads to an oversight that is responsible for one of the chief mysteries of perception: why perceivers perceive percepts and not neural activity or physical reality. Photons may stream through the lens of the eye and neurons become active, but neither photons nor neural activity are perceived. Why? There is a deafening silence today regarding this issue that can no longer be brushed aside. It is, after all, the defining property of perception that it is the percept that is perceived. It is also the basic stumbling block to the acceptance of materialist perceptual theories that they have been unable to explain how neural activity relates to perceived qualities.

The solution may be found by reconsidering the available data. The new model proposes that there is a solution to the mystery, and that it is to be found by looking at what is created by the sense organs and not within the neural system. Consider visual perception. All visual percepts are basically complex configurations of light. Neural activity is not light nor does such activity produce light whatever promises may have been made by representation-based cognitivist theories in the past. However, the sense organ, the lens in this case, does create a complex light phenomenon that is projected onto the back of the eye. This phenomenon is the actual stuff or raw material of visual perception and ought to have interested theorists enormously, but it hasn't. The conceptual bias of neurocentrism did not allow theorists to admit that the pre-neural phenomena in sense organs could be directly perceptually accessible without neuronal intervention. Yet the sense organs do create within the perceptual system the complex light phenomena that are eventually articulated into perceived features and objects. Recognizing this, the new model proposes that neural activity need not be 'transformed' into a light phenomenon in the brain, nor is there any need to represent the light neurally. One does not need to copy, or create a neural copy, of a phenomenon that is already present in and created by the perceptual system and hence available to the organism.

However, this does not mean that the percept already exists in the sense organ. Sense organs alone do not create the percept. The percept is the articulated phenomenal event as that articulation is used by the whole organism, and articulation is the result of neural activity according to the new model. The 'phenomenal fabric' is but the cloth out of which the percept is articulated. The phenomenal basis of the percept is created within sense organs. Its phenomenality consists in the fact that it is a complex, but as yet undifferentiated, sensory content directly apprehended by the organism without the intervention of neural activity. It is not articulated into features, nor is it as yet 'objectified' by the sense organ, and hence is not to be identified with the percept, but it is the phenomenal basis for all subsequent levels of perceptual system functioning.

Proposition Two *Level One neurons in perceptual systems have two functions: they 'shatter', with their selective response abilities, the holistic phenomenal fabric created by the sense organs, and secondly, they create features by means of contrast usage.*

Today it is generally accepted by neuroscientists that neural activity in perceptual systems can be divided into two distinct levels of functioning (see Engel et al., 1992).[5] The new model accepts the division, but redefines both levels in keeping with its nonrepresentational interpretation. Level One neurons include receptor and postreceptor neurons. These neurons function singly or as members of neural networks (groups of neurons that are linked together through feedback connections and that become active as a group rather than singly). Level One neurons are organized in a hierarchical fashion with succeeding levels of activity dependent upon the results of earlier levels of functioning. Neural activity at this first level is highly parallel in nature.

According to current thinking, Level One neurons first represent isolated, and then sequentially more complex, features of the stimulus array. They are thought to internalize, represent, and begin to assemble an internal correlate of the stimulus. hence receptor neurons have been dubbed 'feature detectors' (Barlow, 1953), although this representational reading of the data was based solely on the discovery that individual receptors are *selectively sensitive* to particular stimuli. For example, the selective sensitivity of a ganglion cell in the eye of a frog to the presentation of a moving black spot led to the claim that this neuron was a 'bug detector' whose activity represented the presence of a fly. The conceptual leap from selectivity of response to internal representation passed without comment in the literature. Later research shifted attention to neural activity located deeper within the perceptual system (Hubel and Wiesel, 1962). In the visual cortex, for example, neurons were discovered that responded selectively to the movement of a light stimulus and to more complex kinds of stimuli. These post-receptor neurons received input simultaneously from different classes of receptor neurons selective for different stimuli and were therefore thought to represent compound features of the external stimulus. It was a small step to conclude from these findings that the combinatorial process continued within the brain to produce eventually a complete internal neural correlate of the external stimulus array.

But small though it may have seemed, it was a decisive and eventually fatal step for perceptual neuroscience which became the experimental quest in search of the complete neural correlate of the percept. Nearly half a century later the goal of finding this reconstructed correlate still eludes researchers. The problem today is referred to as the 'binding problem'. In response to this, the new model makes the following proposal. First, jettison the neurocentric premise regarding perceptual system functioning and adopt the hypothesis that sense organs (such as the lens of the eye) make direct contributions to the percept without neural intervention. The new model suggests that the binding problem remains unsolved, not because the neural processes responsible for binding have eluded researchers, but because the neurocentric conceptual framework with which neuroscientists have approached their data forced neuroscientists to look for a neural process that does not exist.

The new model proposes that the percept's holistic nature is the second major contribution to the percept made by sense organ functioning, the first being its creation of the percept's phenomenal fabric. Recall that I said earlier that the complexity of the phenomenal fabric, although present in the sense organ, remains unarticulated until neural

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[5] The data to support the distinction between two levels of neural functioning are based on early work by researchers such as Barlow (1953) and by Hubel and Weisel (1959). Barlow's seminal paper of 1972 heavily influenced subsequent research in the field of perception. What follows is a brief summary of the findings on the subject collected during the past half century.

activity takes place. This means that the phenomenal fabric exists as a unified whole at the outset. Its holism or undifferentiated character is also perceptually available without neural intervention according to the new model, just as the phenomenality of that undifferentiated whole is available to the organism. Thus I suggest that creation of the percept as a holistic phenomenon is accomplished by the sense organs *at the very outset of the perceptual process* and that it is not the task of neurons to compile such wholes. If this interpretation is correct, then it is understandable why a complete neural correlate of the percept has never been discovered by researchers: there isn't one. Thus, the binding problem is eliminated.

But if neurons are not in the combinatorial business of building up perceptual wholes out of features and, furthermore, if they do not represent features as cognitivism maintains, then what do neurons contribute to perception? Proposition Two characterizes the achievements of the two forms of neural activity taking place at Level One without appeal to representations or the concept of binding. The first form of functioning involved at Level One is, as we have seen, the selective functioning of receptor neurons that are stimulus-specific in terms of their response characteristics. Each receptor neuron responds maximally (i.e., with a burst of intense electrical activity) to a specific type or class of stimuli. Moreover, receptor neurons do not interact among themselves. The activity of each receptor neuron occurs independently of the activity of other receptors because they share no connections and therefore have no feedback connections. This means that receptor neurons are not only narrowly selective in relation to the phenomenal event created by the sense organs, but that receptors also effectively hold the stimuli that they react to in isolation because they do not interact among themselves.

Based on these data concerning neural functioning, the new model proposes that receptor neurons are the means by which the holistic phenomenal events created by sense organs are *shattered*, broken up, or articulated into parts. Because there are many different types of receptors selective for many different kinds of physical stimuli, they effectively create complexity *vis-à-vis* the previously unarticulated phenomenal event in the sense organ by means of their finely tuned response characteristics. Shattering into isolated parts is by no means a trivial accomplishment. Remember that holism (integration, connection) is the fundamental condition of reality and that the phenomenal event in the sense organ shares this universal characteristic. But because receptors operate in isolation from one another, they effectively isolate their triggering stimuli for the organism, even though the stimuli actually exist in an undifferentiated state in the sense organ. In this way aspects of the phenomenal event to which individual receptor neurons react inherit discreteness from the way in which they are 'used' by the organism. The phenomenal event in the sense organ acquires its articulation because perceptual systems interact with it in an analytical fashion.

Receptor functioning is followed by post-receptor activity in perceptual systems, a second form of Level One neural activity. Post-receptors are differently connected than receptor neurons and hence function differently with respect to the sense organ event. Because they function in a new way, they constitute a different form of use.

This form of use results in the generation of perceptual features. Post-receptor functioning includes the activity of neurons acting singly and within neural networks of all sizes, but its defining characteristic is that post-receptor neurons interact via feedback relations with other neurons. Post-receptors deal with the phenomenal event occurring within the sense organ at one remove, as it were – they react to the phenomenal fabric as shattered by receptor neurons.

Post-receptors engage in different forms of contrast functioning. Contrast is a form of neural activity that involves so called ‘opponent mechanisms’. A simple example of contrast functioning is provided by the activity of a type of post-receptor neuron in the eye, the ganglion cell. Ganglion neurons receive input from two different types of receptor neurons sensitive to the same local region of the retina (called the ganglion’s receptive field). One of these receptor neurons inhibits (stops or slows) the bursting activity of the ganglion and the other excites (starts or speeds up) the activity of the ganglion. The input from the two types of receptors can be organized in various ways at the ganglion. For example, a ganglion neuron may have what is called an on-centre, off-surround arrangement. This means that when the ganglion neuron receives input from a receptor sensitive to the central area of its receptive field, the ganglion neuron becomes active. However, if receptor neurons sensitive to the outer portion of its receptive field (the surround) should become active, they will inhibit the activity of the ganglion neuron. In essence, therefore, the ganglion post-receptor neuron effectively contrasts one receptor neuron’s input with another receptor’s input. All post-receptor neurons act in this way, as contrast mechanisms, although not all contrast is achieved by on-centre, off-surround mechanisms. The contrasted input may be from different locations in the receptive field of the post-receptor neuron, or it may involve input from receptors sensitive to different kinds of triggering stimuli or input from different post-receptor neurons (either individual post-receptors or from networks of post-receptor neurons). But in the end it comes down to this: post-receptor activity is the way that perceptual systems have evolved to be able to contrast what was isolated by receptor neurons from the holistic phenomenal fabric created by sense organs.

Features are dependent phenomena. Every feature acquires its unique nature as a feature in a process of contrast. Contrast, in turn, requires the prior isolation of the phenomena that are brought into the relation of contrast. The colour red, for example acquires its character because (1) a particular wavelength of light is isolated and (2) is then contrasted within the visual system with the wavelength of light that humans perceive as green (rather than yellow or blue). Features require contrast mechanisms and this is why, in the absence of light opponency mechanisms like those that occur in the visual system, there are no colours. Light remains, but not colour. Thus, an argument can be made that it is fundamentally incorrect to refer to receptor neurons as ‘feature detectors’, although this is the term that is generally used today, because contrast does not occur at the level of receptor activity (it first occurs at the level of post-receptor activity).

But how can we explain the genesis of features by post-receptors without appeal to the notion of representation? Here the new model introduces the concept of ‘use’: it views receptor and post-receptor activity as *ways in which the organism does something with the phenomenal event*, rather than as neural representations of that event. This is significant. Forms of use are inherently ‘creative’, and their creativity creates the meaning of the phenomena that are used. One example of this creativity has already been mentioned, that of stimulus specificity in relation to receptor activity. The discreteness of components of the phenomenal event created by sense organs, I claimed, is not copied from that event; it is bestowed on it by virtue of the isolated way in which it is used by receptor neurons.

The concept of use can also be applied to feature generation by post-receptor neurons. The colour feature red, for example is not just a particular frequency of light wave considered in isolation. Different frequencies of light acquire their unique colour characters from being contrasted with one another. Light is not a perceived feature, colour is: and the physical phenomenon, light, acquires its unique colour character when contrasted by post-receptor neurons in the human visual system with light isolated by so-called green receptor neurons. Moreover, red would not be the phenomenal colour that it is if the same light frequency were contrasted with some other light frequency rather than that which green receptor neurons isolate. For example, in avian visual systems, although the same light frequency that generates the colour red in the human visual system is isolated by receptor neurons; it is contrasted with infra-red and ultra-violet spectra of light. Hence the self-same frequency does not have the same phenomenal character as red does for human beings. What has changed is not the type of light wave isolated by receptor neurons in each case, but the contrast relations into which it has been brought by post-receptors. The result is a new perceived colour, a colour feature incommensurate with our own (Varela *et al*., 1991).

Use makes it so. Use endows what is used with its character, its functional meaning for the organism. It is not the physical nature of what is used that determines its functional meaning and character. Of course, the physical substrate must be able to support the kind of use to which it is put; it must be the sort of phenomenon that can be used as colour (*viz*., light). But it is the use of that physical substrate by way of contrast that endows it with its quality as a feature of a particular sort. Thus, representations are replaced with the organism's use of the results of its own interactive functioning in the world.

Proposition Three *Level Two neural activity is the activity of globally distributed neural masses. Its primary function is to create 'system behavior' and thereby to articulate the organism whole into distinctly functioning subsystems of use.*

Level Two neural activity is sometimes identified with the activity of very large neural networks, so-called supernetworks. The data, however, indicate that neurons within supernetworks exhibit synchronized activity when presented with a stimulus such a s a moving bar of light with a particular orientation (Gray and Singer, 1987). Desynchronizing connections are thought to exist between neurons with widely divergent orientation preferences. Does such activity represent a distinct form of functioning, a form of activity that could be categorized as belonging to a different functional level than that which is defined as Level One? I think not.

According to researchers, neurons in supernetworks are narrowly tuned and stimulus specific. Moreover, it seems clear that synchronization and desynchronization are essentially contrast mechanisms that pit one stimulus against another. These data suggest, therefore, that supernetwork activity is actually a form of Level One neural activity. The scale of neural involvement differs – e.g., from single neurons and small neural networks to supernetworks – but the functional attributes of that activity are the same as that occurring in Level One. For this reason, the present model classifies supernetwork activity as a form of Level One neural activity.

According to the new model, true Level Two neural activity can be defined as neural behavior collectively generated by tens of thousands of interconnected neurons.

This form of activity is referred to as 'neural mass action' (Freeman, 1975). Unlike network activity, neural mass action is true system behavior, like that of a wave in the ocean. Just as there are innumerable water molecules in a wave, there are tens of thousands of neurons involved in neural mass action within the brain. Like the wave, neural mass action occurs only when masses of neurons function as a unit to create a coherent form of system behaviour whose properties and effects are irreducible to the properties and effects capable of being produced by its components.

Perceptual functioning, not coincidentally, also happens to be a form of system activity. This raises an important issue that is not ordinarily addressed. How is such system activity created so that it is available to the organism as an identifiable system? Level One neural activity is not system activity; and even supernetwork activity is not system-wide activity. For example, in the olfactory bulb, research has shown that neural network activity involves perhaps 1-5 per cent of bulbar neurons (Skarda and Freeman, 1987); hardly the whole system. So how is the system qua system generated?

The new model suggests that a neural system is created when neural mass activity is generated within the brain. Systems, thus defined, are dynamic realities, not statically defined anatomical regions. The anatomical definition of the system is actually a third person or observational reality. Dynamically created system activity is the way in which the system qua system is available to the organism itself as part of its functioning. Therefore one essential task for brains must be to create systems of unified functioning for the organism as a whole. This is the function of neural mass activity according to the present model.

Neural mass action is a form of neural activity involving mechanisms not utilized in the formation and activity of neural networks and other Level One processes. In the brain, whole populations of neurons are interconnected by excitatory and inhibitory connections, forming pairs of excitatory and inhibitory neural populations. Negative feedback takes place between excitatory and inhibitory populations, and unfolds in a number of stages (Freeman, 1991). First, the excitatory population becomes active and activates the inhibitory population. The activity of the inhibitory population is then fed back onto the excitatory population, thus inhibiting its activity. This is negative feedback. Negative feedback occurs throughout the brain. When the excitatory activity is inhibited, however, the excitatory population's input to the inhibitory population decreases. This allows for a new burst of activity on the part of the excitatory population, and the whole cycle repeats itself. The result is a pattern of on-off activity that is referred to as 'oscillatory behavior'. Oscillatory behaviour is the behaviour characteristic of neural masses.

Returning to the new model's claim that neural mass action represents a distinct level of neural functioning in the brain, the reasoning proceeds as follows. When an entire neural mass becomes active, a mass that involves every neuron in the region, contrast functioning among neurons in the system is ruled out within that population. There is nothing else going on in the region with which such global activity can be contrasted. Thus, mass action is not a form of contrast functioning. And since contrast functioning is defined by the present model as a form of functioning responsible for creating perceptual features, neural mass action is not in the business of feature generation. So what is it doing and how can it be understood if we reject the representational reading of cognitivist neuroscientific accounts?

Before answering this question, we need to review a few more findings about neural mass activity in perceptual systems (Freeman and Schneider, 1982; Freeman and Skarda, 1985). In the olfactory system, the correlation between the stimulus and neural mass activity was anything but the tight fit predicted by the representation hypothesis. For example, when an identical odourant stimulus was presented to different animals, animals trained to give identical responses to it, different patterns of neural activity were recorded from each animal. The patterns, thus, correlated with the animals, not the stimulus. Additionally, the patterned activity that resulted from the presentation of the same odourant to the same animal was never twice the same. Instead, the patterns possessed a kind of family resemblance. And when animals trained to respond to odourants were taught to respond to a new odourant, or when the response contingency for a previously learned odourant was changed, all of the recorded patterns associated with previously learned odourants changed. Finally, and very significantly for the new model, when feedback connections between the perceptual subsystem and the rest of the brain were severed, neural mass action failed to occur. What can we conclude from these data?

First, the data lend support to the interpretation of neural activity in terms of the concept of use rather than that of representation. Forms of use are context dependent. they acquire their distinctive character in relation to other forms of use (Wittgenstein, 1953). The context dependency of use is significant because it would offer a simple and rather elegant explanation as to why the introduction of a new odourant stimulus led to changes in all of the recorded EEG patterns associated with previously learned odourants. If the recorded patterns of neural mass activity correlate with perceptual forms of use, then one would predict that the introduction of new forms of use would change the meaning of the entire context of related uses. A form of use cannot remain the same when the context that defines it changes, and the data reflect this context dependency.

Moreover, it is also characteristic of forms of use that they are never strictly identical over time even though they may serve as functional equivalents. We know this from ordinary everyday experience of forms of use. Take bicycle riding as one example. As a form of behaviour, bicycle riding is not definable in terms of a set of features that apply to every instance. What counts as bicycle riding changes depending on the context. It is one set of bodily movements, postures, balances and counterbalances when riding up a steep hill, but can be quite different behaviour when riding downhill or over bumpy terrain. It can be done without using one's hands, without putting both feet (or any foot) on the pedals, while standing or sitting down. The behavioural variations are endless. My point is that there is no one form of behaviour that is bicycle riding in every case, although there can be said to be a family resemblance among all instances of the form of use that is referred to generically as bicycle riding. A form of use is a generic (never identical) form of context dependent interaction engaged in by organisms. The family resemblance of the recorded EEG patterns of neural mass activity generated in response to an identical stimulus support the interpretation of them in terms of the concept of use. If the patterned activity were an internal representative (correlate, stand in for, image, copy) of the external stimulus (the organism's only clue to the external state of affairs), then one would expect that external identity would map with identity in its internal correlate. But this is not what we see.

The finding, however, that is of central importance for determining the essential role of neural mass action (Level Two activity) in perception, is that such activity does not occur if connections between the olfactory bulb (sensory subsystem) and the cortex are severed. Computer simulation of the olfactory system, including the prepyriform cortex, indicates that neural mass action taking place in the cortex is required to push the olfactory bulb away from its rest state. This, in turn, creates the state of instability required for neural mass action to be generated in the bulb. Once destabilized, Freeman's simulation showed, the neural mass in the bulb is able to respond to local network activity (Level One neural activity) with global, system-wide oscillatory behaviour. Thus, neural systems as dynamic entities are created by means of feedback with other systems. They are co-defined and co-created by way of interaction taking place among neural masses. Extrapolating from these data, the new model proposes that neural mass action effectively carves up (articulates) organismic functioning by dynamically creating subsystems of functioning. This is the chief contribution of Level Two neural functioning according to the new model.

Before continuing to the final proposition concerning perceptual system functioning, however, one more feature of neural mass activity warrants comment. Neural mass activity is self-organized. Briefly, self-organized behaviour is behaviour generated by enourmous groups of component elements that share dense feedback connections. The collective form of behaviour that arises is not imposed from outside the system, rather it is spontaneously generated by the collective itself under certain conditions. Much has been made, in recent years, of the fact that neural activity is self-organized but in relation to the proposed new model it would seem that self-organization relates in an interesting way to the claim that Level Two neural activity is responsible for articulating the organism into behavioural subsystems. Organismic articulation cannot be borrowed or copied from the extra-organismic world. It must be internally generated by the organism itself if it is to exist at all. Which means that organisms must themselves generate a form of dynamics that can provide such articulation. Self-organized neural activity fits the bill. The new model, proposes that Level Two neural activity is essential for perception because without it there would be no *perceptual system event*. Although its physical nature is holistic (inescapable connectivity is the fundamental nature of reality), organismic functioning is a tale of articulation.

Proposition Four *Whole-organism functioning, which contrasts two results of Level Two neural activity, creates the subject-object form of use. This form of use is what is referred to as perceptual consciousness.*

Proposition Four extrapolates speculatively from the data that form the bases for the first three propositions of the new model. Speculative though it may be, it addresses an issue that is of pivotal importance for any theory of perception. For what is perceived appears as something other than the perceiver in the sense of being an object of perceptual activity; and just as all of the other features of the percept, its objectivity, too, must be perceptually generated. It is an issue that cannot be ignored, not even by those wedded to materialistic interpretations of perception, since it is undeniable from the way that percepts function in behaviour that they enjoy an objective status from the perspective of the behaving organism. Moreover, since what is objective acquires its objective status only in relation to what is subjective, the implication is that eventually perceptual theorists must address the issue of perceptual experience as well. Proposition Four is offered as a possible way forward on this front.

The view of perceptual consciousness adopted by the new model is novel. Consciousness is defined first as a form of whole organism use. Unlike materialism, the present model does not equate consciousness with any part or component of the organism, such as neurons, networks or neural masses. Neurons are not conscious: perceiving organisms are. Nor is perceptual consciousness something purely subjective as opposed to physical. Such a view would make the present model into a form of idealism, an extreme of thinking that it disavows along with materialism.

The new model proposes that perceptual consciousness is based on the results of neural activity, but is not itself a form of neural activity. Thus, the new model draws a distinction between the bases used (results of Level Two neural activity) and the use made of them. Consciousness is here defined as a ‘structure of behaviour', a field of action defined by a specific form of use engaged in by organisms. Moreover, consciousness is a form of use that itself generates both the perceiver as subject and the percept as object. Therefore, consciousness is the precondition for subjectivity and objectivity and thus should not be identified with the subjective sphere, as idealism claims, or with the objective sphere (which is ultimately defined as material reality), as materialism and scientific realism claim. It is a form of use engaged in by the whole organism in which a gap is introduced that generates the perceiver as subject and the percept’s objective status.

Perceived objectivity results, according to the new model, when the organism makes use of the results of the perceptual system event as ‘other’. This presupposes that three interrelated process occur.

1. That there be a system event that defines the perceptual system qua system providing the basis for objectivity.
2. That the result of the perceptual system event be distinguished by the organism from the rest of its own functioning occurring simultaneously, a process that generates the ‘self’ by way of contrast.
3. That the entire process be ‘undergone’ by the organism, be part of its own functioning, thus generating its ‘experiential’ character.

Two aspects of global mass action within the perceptual system itself create the basis for the form of use by which the whole organism generates an objectified percept. When a perceptual system event is created by neural mass action, that event adopts a unique form of patterned activity. Neural mass action exhibits a specific pattern in each case because it is shaped by the forms of Level One feature functioning taking place within the perceptual subsystem. According to Freeman’s model, this is how it happens. The neural mass is destabilized from its ground state just prior to becoming active as a whole. At this point Level One activity, taking place in localized neural networks responsible for feature generation, biases the neural mass in such a way that the resulting mass action reflects the results of Level One feature activity by adopting a unique form or pattern of mass activity. Here the suggestion is made that this process effectively reconfigures the results of Level One functioning in relation to the phenomenal fabric so that they are made available as the output of the system to the rest of the organism. The reconfiguration is necessary, not to bind together features, but (1) to provide the organism as a whole with access to the results of the complete articulation of the sense organ event and (2) to create a system event which it can then use as a unified entity. This is the first step required for the generation of perceptual consciousness. There must be some unified basis available to the organism for use as objective.

The second feature of mass action as a system event that contributes to perceptual objectivity is that the perceptual system event is generated only when there is feedback from the rest of the brain. The correlation that is here observed reflects the interdependency that always exists between subject and object. An object can only exist in relation to a subject, and correlatively nothing can be a subject except in relation to something objective. The two concepts acquire their meaning only in relation to one another. This is the sort of relational process, as Freeman's model indicates, that occurs within the brain. Perceptual system activity is created and defined as a subsystem event by way of feedback occurring between that system event and the rest of the brain. This implies that global mass action taking place within the perceptual system not only generates the unified basis for what gets used as perceived object, but that it also effectively generates what becomes defined as the 'rest of the organism' by way of feedback. That remainder, which effectively comprises the organism whole, becomes the basis for the form of use that pits the subject against the object. The result of this process of contrast between the subsystem and the rest of the organism provides the bases for two segregated forms of use. This form of use is that which creates the subject/object poles, the gap between the self and its objects. For in order to become aware of appearances we must first be free to establish a certain distance between ourselves and the object (Arendt, 1961). Thus, the new model suggests that the organism uses its own dynamics in a way that allows it to carve up its own holistic nature (its physical reality) into what it then uses as 'self' and 'other'.

The final piece to the puzzle of perceptual consciousness relates to its experiential character. This feature, I believe, is contributed by the fact that the entire process which generates the subject/object relation as well as the holism and articulation of the phenomenal event taking place in the sense organs is undergone by the organism itself. That is, the process is something that the organism lives in its own functioning. This is the basis of the experiential character of perceptual consciousness. It is the living of the process that gives rise to the percept that explains the experiential character of perception. And the percept's perceptual reality is crucial here. For it is the fact that percepts are facts about a form of life that lends to the perceived object and its features its character of being something experienced.

Thus, perceptual objectivity and its correlate, the perceiving subject, have their bases in organismic functioning. Perceived objects are not located outside of the perceiver any more that subjectivity is localized within the organism. Both are the results of a uniquely structured form of use generated by life forms that have the ability to articulate their own dynamical functioning in a particular way. One form of use cannot exist without the other. And as the result of a form of use, percepts cannot be copied from the extra-organismic environment. Indeed, it is organismic functioning itself that defines what counts as extra organismic in the first place.

But why is it that organisms can behave successfully as if they were independent of the world that they perceive? Perception works. I believe, essentially because nothing exists in the way that perceivers perceive it to exist. The holism, the inescapable relationships, remain in place. Percepts are used as if there were independent states of affairs, but they are actually an articulation of the organism's causal embeddedness in physical reality. All organismic processes necessarily reflect the causal history of embeddedness of the organism. So although perception essentially obscures its own origins by projecting discreteness upon what exists holistically, it can do so and still facilitate a form of behaviour because those articulations remain part of the fundamental holism of physical reality. This is the remarkable achievement of the perceptual form of life.