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Neural Architecture and Extroverted Consciousness

This essay will explore the high level physical and operational aspects of neural architecture and their relation to conscious operations and contents with respect to the emergence of extroverted consciousness. To orient the discussion, we will indicate some aspects of the explanatory context we are assuming. In the place of hierarchy theory with its notions of levels of organization we work within an alternative view of a non-systematic organic whole where the parts are understood in terms of nested explanatory contexts. In a non-systematic whole, everything is not related to everything else, but everything is related to something that is related to something else, so that all the parts do not need to be interrelated. This permits an aggregate of elements and relations that in turn constitutes the potency of the whole to perform in relation to itself and to the other, or what is not it, and to develop. In such a whole it is possible to have structure, system and systematic processes without the whole being fully systematic. This permits organisms to live in situations which are not fully systematic. It also provides evolutionary gradients towards greater complexity, greater variability and greater flexibility. The non-systematic is intrinsic to life which makes life itself the primary evolutionary driver evidenced in the correlation of increasing evolutionary differentiation with evolutionary acceleration.

Though parts of the whole may be isolated from one another, they are not isolated from the whole itself. Though they can be studied abstractly as if they were isolated, there comes a point where their fuller context needs to be invoked to explain their operation. These are classic tenets of holism. To them we add the notion that there is no central organization of the organism. There are operators and what may be considered centers of organization and even of self organization. Its as if they work in contexts they did not create for reasons they may not know to meet ends or goals they may not foresee.

Neural structure approximates a non-systematic whole. It only approximates it because it is actually a "part" understood in the context of the organic integration of neural and non-neural organic or biochemical processes. This integration is, for the most part, constitutive of the organism as a whole.

Neural – Somatic Integration

In addition to the motor and sensory systems, there are two other types of neural-somatic integration. These are interrelations via the autonomic nervous system and mediation of each by the other via biochemical interactions. The autonomic nervous system innervates the smooth and cardiac muscles, the involuntary muscles, and the glands among other areas. It has two principle subsystems, the sympathetic and the parasympathetic, which perform contrary operations. While the sympathetic systems works primarily through direct contact with muscles, skin, blood vessels, and so on, the parasympathetic works primarily by inhibiting the sympathetic. For example, the sympathetic subsystem can stop intestinal peristalsis, make hairs stand on end, facilitate breathing by expanding the

bronchial tubes, reduce activity in the gastrointestinal tract, increase heart activity and blood pressure, while reducing the supply of blood to the skin by constricting the vessels supplying it, dilate the pupil of the eye, increase the size of the visual field by contracting muscles to cause the eyelid to lift and the eye to move forward in the eye socket. All of this occurs during the acute stress response (fight or flight). The system uses norepinephrine as a neurotransmitter which contributes to alertness. The parasympathetic can cause the blood vessels to "widen" by inhibiting their contraction by the sympathetic system. However, it also has some direct effects as in the deceleration of the heart rate and the constriction of the pupil. In the fight or flight, or acute stress response, we can think of the sympathetic system as activating and the parasympathetic as calming.

In addition to neural modes of integration of somatic functions, there also are biochemical modes. In general, cells relate via biochemicals that include hormones, monoamines, and peptides, which can be synthesized in multiple areas of the body. These biochemicals (ligands) work by attaching to sites which are receptors on or within cells. This can activate a cascade of processes within the cell which can lead to cell growth or differentiation or the release of other biochemicals. There are thousands of types of sites which permit a complex set of interactions. Though the brain may be the most complex whole in the universe, it was preceded evolutionarily by highly complex processes for coordinating cellular interactions, growth and behavior of more primitive organisms.

The brain influences somatic processes by producing hormones, neural transmitters, peptides, etc of its own. Their release into the blood stream can coordinate both global and local physiological responses. They are related to immune response, sexual behavior, and the acute stress response for example. The primary system works via the hypothalamus and the pituitary gland. Here there are direct neural connections to the bloodstream which permits chemicals that cannot get through the blood brain barrier to be released from the brain or introduced to it.

Neurons release hormones that affect the rest of the body directly into the blood stream at a site near the pituitary gland. This cluster of neurons also is receptive to biochemicals in the blood. This permits brain-somatic interactions to go both ways. For example, the slackening of blood vessels indicates a drop in blood pressure. This triggers the somatic release of peptides which, when received by the neurons at this site, initiates a cascade of neural processing resulting in the increase of blood pressure.

This two-way interaction contributes to the emergence of emotions and moods. The events leading to stress or to depression can originate in either neural or somatic processing. Events in the immune system can influence mood via peptides which are utilized throughout the body. Their somatic release can activate neural activity via the pituitary pathway so that emotions can have visceral as well as neural origins.

We see similar interaction in the activity of hormones produced by neurons and released via the pituitary which can relate somatic and behavioral development, the most obvious example being in puberty.

The aim of the above is not to provide an anatomy lesson, but to illustrate that the brain has multiple functions beyond enabling conscious operations and that these functions need to be understood biochemically. After all, all cells have the ability to generate an action potential that travels along the cell. Neurons are just specialists at doing so. The neural-somatic integration trades on the somatic origins of the nervous system.

Neural Architecture

By neural architecture we mean the spatial relation of neurons and neural structures in general to one another and to the other parts of the body with which they interact. We will provide four examples of neural organizations. The first is unicellular where one neuron affects multiple areas. For example, one neuron can terminate on multiple skeletal muscle fibers permitting a synchronous contraction of the muscle. The second is a centrally functioning neural net that is a skein or “tangle” of neurons, that projects outward to multiple areas and receives multiple inputs. This is the form of the spider’s brain, for example, which functions as an intermediate net between sensory and motor neurons. The reticular formation is similarly “disordered” as are some neural nuclei which perform key functions. (Nuclei is being used in the neuroanatomical sense to indicate a cluster or group of neurons with a common function.) The third type is columnar where columns may be functional units. Similar types of neurons’ projections are limited to other neurons within the column providing a synchronized firing of neurons within the column. There also are projections from the columns to other columns or neural areas that interrelate columnar function with functioning in other areas. Likewise, reciprocating projections from other areas terminate on the columns. This type of organization is prevalent in the neocortex. The fourth is radiating. In other words, neurons with common functions converge on a central site or radiate from a central site to multiple areas. The high level architecture of the sensory and motor systems reflect this structure with sensory neurons on the periphery projecting to areas in the brain and motor neurons projecting out from the center to the periphery. Areas with broad radiating convergences and divergences would seem to be instrumental to coordinated activity across the brain or organism. Another example is the serotonergic projections from the raphe nuclei in the mid brain to virtually all areas of the central nervous system. Serotonin has multiple effects, but a key one is in the modulation of moods. Similarly architected neurons project for norepinephrine and dopamine from areas in the midbrain. They also have multiple effects including influencing moods.

The brain is not one structure, but a set of structures. Via evolution, operations were modified or added via the emergence of neural structures. According to one popular theory, if we move from the brainstem upwards to the frontal cortex it is possible to trace the likely sequence of emergence of neural structures from the reptilian to the mammalian to the human brain. For example, the limbic system is grouped above the brainstem. It consists of a set of structures which form a ring. These include the hippocampus, the gyrus fornicatus and the amygdala. (p. 125) The hippocampus is associated with the formation of long term memories. If the hippocampus is removed a person's former long term memories remain operative, but no new ones can be formed. (p. 124) The amygdala plays a role in the emergence of feelings. If it is stimulated during neural surgery patients will report feelings of anger or fear for example. All of these structures project to the hypothalamus and the hypothalamus has neurons which reciprocate the relation. All are also related to the thalamus which has reciprocating projections to and from the neocortex and virtually every other key neural area. The basic mammalian brain has these gross structures though the quantity of neocortex varies widely with the more advanced mammals having proportionately more. The reticular formation is a very early emergent that may trace its origin to the primitive neural net. It extends from below the brainstem to the mid-brain and has projections to and from the neocortex and virtually all other major structures. Part of it,

the reticular activating system is associated with waking and sleeping, general alertness and attention. It is involved in virtually all conscious activity. Conscious activity itself is associated with numerous neural centers, but not all need be active simultaneously. For example, as attention shifts areas of activity in the neocortex change as centers associated with a particular pattern of activity or interest are engaged. (This has been demonstrated using PET scans).

Modeling Neural Processing

Neural architecture can be described as matrical. Minimally, the brain can be considered as a sets of matrices of matrices of neurons. Combinations of neurons map to operations. This does not mean that there are mathematically infinite operational possibilities. There is an indeterminate number that is limited via constraints. Consider the network of motor neurons that enables the coordination of hand movements. The motor neural network is an “organizer of the hand”, but it cannot organize independently of its materials. The range of positions is dependent on the structure of the muscles, bones, tendons and so on in the hand. Though there are limitations, the range of combinations is very large. Consider the finger positions required to play all musical instruments, for example. We find a similar situation with vision. Due to the matrical neural relations and the combinations they support, the visual system can support a bound “indeterminacy” of visual experience. First, there are more than a million rods and cones in the eye. Second, they are specialized in terms of function, creating more possibilities for sets of combinations. Third, they interact with an elaborate set of neural structures for further processing and for integration with other neural modes giving us the potential to see all possible movies or all possible sunsets.

The matrical architecture is scalable. Scalability refers to the capability of an architecture to support greater complexity and size while retaining its core structure. On the macro level we find the same complexity of neural mapping we encountered in describing the organization of neural columns in the neocortex. There are reciprocating connections among all major neural structures. In cases such as the mapping of the digits on the hand to the neocortex it approximates one to one mappings with the digits having their contiguous sets of neurons. However, with the reciprocating projections of multiple areas to one another is it possible to have several non-contiguous areas involved in a single process. For example in vision there are more than 32 non-contiguous specialized processing areas in the neocortex. This multi-area processing occurs with the other major senses also.

Just as the matrical architecture is scalable, so are the conscious operations it supports. How this occurs exactly is not firmly established scientifically, but a useful model is provided by Edelman. Neural function which underlies perception and behavior relies on neuronal groups which map complexly to one another constituting a primary repertoire of operations. This repertoire is dynamically structured via mappings of neural activity across the groups. It is refined via the development of mappings. This occurs via a selective process where the degree of neural activity determines which mappings develop via both enlargement, by incorporating more neurons, and facilitation. Induced by the activation of neurons, facilitation results from individual neurons creating more synapses increasing the likelihood of innervating their other neuronal contacts. These changes facilitate the reoccurrence of similar patterned activity. The neuronal

refinements support the secondary repertoire. Since the instigating aggregate can be exogenous as in sensing or endogenous as in hormonal changes, the model can be used to explain sensing as well as biologically based behavioral development. The primary repertoire is illustrated by a baby's ability to move their fingers and to grasp objects at birth. The secondary repertoire is illustrated in the development of fine motor coordination.

It also is possible to have the same process supported via different physical neural mappings. In the visual field, for example, the positions of structures are not static. Our viewing of an object is perspectival, in that we see it from different angles, in different light and so on. However, more simply, it can be the case that the perspective is virtually the same, but it has assumed a different relative position within the visual field. This means that different rods and cones are involved in seeing it. It would seem, then, that different sets of neurons are involved the constitution of the image at one time than at another, yet the same image or gestalt is presented for consciousness. In this case the neural function can be understood as a *dynamic set of operations* which can be actualized across a network of neurons. The network may map fairly tightly to the sensory sources. Since the sources themselves are equipotential with respect to providing elements for dynamic structures the network must be able to handle this variability. The network, then, exhibits its own equipotentiality and is intrinsically plastic. This means that the functioning of the network is not understood simply in terms of its elements, but also in terms of the pattern it constitutes. The network assumes different patterns, but does not determine what they are.

Edelman has a notion of the degeneracy of neuronal groups that is similar to the notion of equipotentiality. Neuronal groups need to be of sufficient size to manage multiple complex mappings of activity. For example the visual system has to have sufficient complexity to distinguish an indeterminate range of possible objects where many may not have been seen before. This requires supporting large numbers of combinatorial possibilities. The neuronal group as a part of the primary repertoire is a set of neurons, any one of which can become specific to the mapping of one of a range of mappings. Since they have no specific function, they are "degenerate". This is akin to the notion of neo-natalism in evolution where the former ontogenic development is arrested permitting the subsequent specification of function at a later time. The neuronal group, then, supports a bound indeterminacy of operations. The degeneracy of the group enables the development of the secondary repertoire via the further structuring of activity at the neuronal level. The recurrence of similar patterns is facilitated through the development of connections (i.e. synapses) between neurons. It cannot totally explain it because this type of processing enables multiple states but does not determine what those states are. The specification of the secondary repertoire can partially explain development, learning, memory and other operations.

These considerations underlie an operational model for memory. For example, we could have a set of elements, or neural operations, which are dynamically structured in complex patterns to support a virtual infinity of possible memories which would emerge via matrixly related combinations of operations. Different memories can emerge at different times from the same complex due to different combinations within the complex. Memories, then, would not be stored, but would emerge.

Selective Systems

In artificial intelligence research one model for understanding sensing is pattern recognition. The implicit assumption is that a pattern is present or pre-existent and there is some process for recognizing it. Though this model may be useful for understanding an evolved organism, it is not sufficient to explain the evolution of pattern recognition. From the standpoint of the evolving organism, there was no pre-existent patterns, but at best, an aggregate. The aggregate is in relation to a set of cells where the cells “transduce” or change the aggregate per se in terms of the organism. For example, sensing is the selective transformation of “inputs” be they wavelengths of light, stimulation of cilia in the ear or chemical interactions in smell. To add to the complexity, the aggregate changes. The question then becomes, if there are patterns to be discerned in the sensed aggregate, how does the organic aggregate get patterned to yield the pattern for the organism?

At a first approximation, if a nerve fires in response to movement in the visual field and if the movement is repetitive, then the frequency of the firing will match the frequency of the movement. If other characteristics that have neural correlates are present the corresponding nerves will fire. There will be a de facto patterning of firing based on a one to one correspondence of one aggregate to another. For the patterning to be more than transitory, for it to mean something for the organism, it needs to be related to organic activity. If at the most primitive level patterns are de facto, for behavior to occur in terms of them the organism needs to be organized to some extent in terms of them. The “external pattern” needs to be matched by some “internal” patterning. For example it is the selection of patterns in terms of performance that underlies anticipation, memory and recognition itself. Edelman uses the model of selective systems to explain how this occurs neurally through his theory of neuronal group selection.

In our terms, in a selective system we have an aggregate of operators (ie. neurons) related to another aggregate. The aggregate could be sensory inputs or other neurons. This means that variety on the side of the aggregate needs to be matched by variety on the side of the selective system. It is the variation on the side of the selective system that determines the range of aspects of the aggregate to which it can be related. The selective system is a priori. The a priori element is its bound operational indeterminacy. But there also is an a posteriori element that arises through interaction with its corresponding aggregate. For example, Edelman notes that “... perceptual categorization usually emerges as a result of selection during actual behavior in the real world.” So seeing a particular color is a posteriori. The capacity to see the color is a priori. Thus birds can see in the ultraviolet range and we cannot, but when we and birds see, we all see something.

In Edelman’s model a selective system has the means of amplifying effects. Frequency of temporally linked (ie. Simultaneous or sequential) use of neurons can lead to the development of synaptic connections that coordinate their firing leading to their selection for patterning. If you recognize that different neural structures support different types of operations or different aspects of single operations, then by propagating this model across neuronal groups you get a sophisticated view of coordination via neural mapping that can spontaneously develop. For example, if frequency of use leads to development of neuronal connections, then the more frequent the instigating aggregate, the more connections. With more connections, then there is a greater probability that the set of neurons will fire in a similar pattern. In fact, we can conceive of a developed

pattern being activated with fewer inputs, permitting anticipation and a type of generalization. The initial patterning then can lead to secondary amplification of other patterns which effect the final patterning which could be a unified experience itself.

A simpler example of selective systems is the initiation of a cocktail party conversation between strangers. In this case we have two intelligently selective systems looking for something to talk about. Each has their own repertoire of topics, their own aggregates. Each tosses out questions seeking some response to which they can relate, a type of sampling. When a response indicates an area of mutual interest, the topic of conversation is selected. The conversation is maintained through the amplification of the interaction based on the degree of interest. Ideally the conversation gets more interesting as it proceeds. Interest can be considered a value, or selective criterion which also guides and sustains the discussion. In neural processing selective criteria may be immanent in the neurons themselves when they are of different types.

While conscious, there always is a dynamic pattern of neural activity that ranges across a set of structures, but there is no fixed structure or set of structures that can unequivocally be identified as the “seat” or “center” of consciousness. All of these areas project to and receive projections from all of the others. In Edelman’s terms, neural architecture utilizes complex “re-entry” networking, which probably accounts for the synchronization of functions across multiple operational areas.

To account for this, Edelman has proposed a dynamic core hypothesis where some set of functional neural clusters is constantly engaged, but the constituents change making consciousness a temporal unity that is a dynamic structure or process. For him this is the thalamocortical system, “... a dense network of reentrant connectivity between the thalamus and the cortex and between different cortical regions through so-called corticocortical fibers.” (43 A Universe of Consciousness)]

Damasio also recognizes consciousness as engaging multiple neural areas simultaneously including cortices, the structures of the mid-brain, the reticular formation and the cerebellum among them. He notes the significance of lesions to the reticular formation in the operational integrity of consciousness. Lesions above the upper pons will result in a loss of consciousness, but lesions below it will not. He hypothesizes that this is because the reticular activating system is operative from the pons upward. From the pons upward, the reticular formation has mappings from all the sensory systems, the neo-cortex, the emotional and memory centers of the mid-brain and virtually every other significant neural mapping available to it. Depending on where lesions occur, capabilities either are eliminated or significantly impaired. Thus it is possible for some to suffer damage and be alert, but not be able to think or speak. There is some degree of consciousness, but not in the operative sense we usually associate with full performance. This is because lesions along the axis result in the loss of conscious operations associated with the neural structures above the lesion. In other words, the basic operations associated with the brain stem remain, along with any other operations supported by neural structures up to the lesion. Consciousness still is supported. As far as we know it remains a whole as experienced, but its content and effective range is decreased since the other areas can no longer be operative as conscious.

Consciousness

By approaching consciousness from the standpoint of phenomenology, versus neural activity, we find multiple elements within a dynamic, temporal whole which are not merely “present” but integrated in differing ways in multiple processes and performances. The variability and complexity of conscious states points to the corresponding variability and complexity in its neural conditioning and enablement. The flexibility of skillful performance, for example, correlates to the bound indeterminacy enabled by neural structure. As a dynamic structure of operations, a skillful performance is analogous to the activity of Edelman’s dynamic core which enables dynamic structures of ongoing neural activity.

The activity of this unity involves intentional operations. As intentional, consciousness is consciousness of. Operations are integrated in complex ways to yield complex objects. An intended entity, such as a tree, is a unity for us only after a series of integrations of operational contents where we find the significance of the contents not in themselves, but in the transcendent object they constitute. Husserl’s noted that the perceived is never fully given, but only presented perspectively. There is a self-transcendence implicit in perception where the perceived is more and other than the perceiver and the perception. The operations are oriented to what they are not, the intended object; and not to that object simply as “given” but as anticipated, as an “incompletely given”.

Fundamentally, in consciousness, the operation and the content are given as one. Consciousness is a quality of the operation. As such the operation as conscious is the presence of the content. It is by understanding that we come to distinguish the content from the operation and consciousness from both. This is possible through two generalizations. The first is that the sensitive operation is in some sense the same though the content may differ. The second is that different kinds of operations are conscious so that consciousness is always present though the operations change. As a quality, consciousness is given along with the operations. So while contents of operations are present by virtue of the operations, consciousness has the appearance, for us, of being present by virtue of itself. That is, for us, in a basic sense, it simply is. As a quality of operations consciousness is an unmediated immediacy. We do not need to do anything to become conscious, because becoming conscious is not a conscious operation.

Consciousness also is a whole. By considering consciousness as a quality of operations, we risk having consciousness disintegrate conceptually into multiple operations. However, the operations can be linked. So if a squirrel sees a hawk it may experience fear and be motivated to take flight. Both seeing the hawk and feeling fear are conscious and they are linked in this case. While we are awake, conscious operations are occurring continuously. Basic alertness characterizes this.

The occurrence of neural deficits may affect what we are conscious of or the manner in which we are conscious, but consciousness itself remains a whole. Thus, stroke victims may not know they have a visual deficit on their left side until they start bumping into things they do not see. Likewise, color blind individuals just see fewer colors.

Consciousness is a unity, but it is not a unity unto itself. For example via the senses the organism is self transcendent in the conscious relating to what is other than it. Also, conscious operations can be interrelated, but this does not mean they occur fully systematically. Sensed patterns, sights, sounds and so on can occur non-systematically requiring changes. Likewise, internal operations such as feelings can arise via somatic

origins motivating conscious changes. Also, it is important to remember that consciousness is a quality of the organism. It is the organism that wakes up, not consciousness. Waking up involves global change throughout the organism.

Origins of Consciousness

When we state that consciousness is a quality, we mean that consciousness is something that cannot exist independently of something else. In this case we are claiming that is a quality of operations. What type of operations? Evidence (ie. PET scans, direct neural stimulation) shows that in many cases they are operations requiring neural functioning. This leads to the supposition that consciousness also is a quality of neural processing.

It is possible that consciousness was a quality immanent in the original neural networks. Its emergence was coincident to the interrelated firing of neurons. We find primitive networks today in jellyfish. The simplest has two types of neurons. The first type is sensitive and the second is motor. They are directly connected to each other. An incipient intentionality is immanent in this primitive network as the sensitive neurons are related to what is other and the motor neurons permit transformation of the organism and its behavior in terms of the other as mediated via the sensitive neurons. The next most complex network has neurons between the sensing and motor neurons permitting self mediation of sensitivity and movement. Rather than terminating directly on motor neurons, sensory neurons terminated on the intermediate ones which in turn innervate the motor neurons. Thus, the intermediate neural net emerged which led to the evolution of the brain. The intermediate net is self mediating in that it acts in terms of its own operations. Since the state of these operations can be conditioned by what is not the organism, the other as mediated via the senses, there is an analogical structure linking the organism and the other. Since the neural net can also “sense itself”, it can organize itself in terms of its own state, which encompasses the state of the other for it. This enables the organization of movements in terms both of the other and of the state of the organism itself. The analogical relation between birds’ movements and the building of a nest would be a sophisticated example of this.

Minimally in the case of the initial neural networks motor patterns could vary based on sensory patterns. The sensory patterns also would vary based on motor activity. The network enables complex behavior. Given this, it makes sense that the evolution of the brain and the evolution of behavior are linked. If we consider that sensory-motor behavior was conscious from the beginning, then the evolution of the brain and consciousness both occurred with the evolutionary differentiation of function and increasing complexity of behavior. The distribution of conscious operations’ neural correlates throughout the brain would argue for this hypothesis. Also, stochastic models of neural function such as selective systems and complex adaptive systems cannot account for unity amongst the aggregates nor their states. If consciousness were a later emergent from a pre-existent neural aggregate it is more difficult to explain why it emerged as well as the original role of the neural net as an aggregate versus a unity. (Of course, this does not rule out this alternative.) Finally, in animal development conscious activity is necessary for neural development. Imprinting periods provide clear examples.

The evolutionary homologues to the primitive sensory system are the cognitive structures while those of the motor system are what may be called, in the broad sense, the

motivating structures that condition behavior. This distinction is artificial to some extent since motor activity is part of cognitive behavior and cognition certainly is part of making choices. For example, the mnemonic and anticipatory functions probably emerged together as undifferentiated within the same neural processes. At its core, memory is a specification of the ability to repeat an operation. If motor operations are transformed via the intermediate net in terms of that net's transformation via recurrent sensitive patterning we have a form of memory. Since the pattern is temporal, it is de facto anticipatory since it implicitly assumes the changing situation to be one it can accommodate with the next action or possible range of actions. So the existential notion of the temporality of consciousness is immanent in the simplest learning or neurally based recurrent operation. The present is the anticipation of the future in terms of the past. With a memory-anticipation structure, innovative activity must emerge to make adjustments in the present situation between the operational situation as anticipated and as actual. This provides evolutionary pressure for the emergence of freedom and intelligence.

The Possibility of Freedom

Unless we confine our definition of freedom to the ability to make meaningful choices, the emergence of freedom in nature is the emergence of a pre-conceptual mode of control. To the extent that it is free, it ranges from being predeliberative and approximating a type of impulsive behavior to the pre-linguistic intelligent insight and deliberation where chimpanzees learn how to unlatch their cages or use tools to get food. Our hypothesis is that some animals have some freedom to perform. Our challenge is to provide a plausible account of how this is possible given the notions of neural architecture and consciousness we have discussed so far.

Actually, this section should be titled "The Necessity of Freedom" because the organism cannot foresee all the situations it will encounter and will not have the resources to determine how to act appropriately in every case to deal with novelty successfully. Actions taken or not taken can have deadly consequences. The actions taken also will rely on the organism's immanent motivations. The emergence of an evolutionary gradient for motivating operations is clearly related to the need to make choices in the situation. Choice is used broadly here and does not always imply freedom, for in many cases the choices may not be free as in the performance of a stereotyped set of escape maneuvers. If we consider freedom in terms of the systems theory notion of degrees of freedom and combine this with the neural model of selective systems, we can get an intelligible account of how the differentiation of motivations could have occurred. We need to be careful to not lose the context that it is the animal deciding rather than the brain.

Though animal decision making may be impulsive, there is an evolutionary wisdom built into it. The "choice" minimally is the invocation of action. It is not some structure or operator within the organism or within consciousness itself that does this. It is the organism itself that does it consciously. It is with the emergence of consciousness that global action can be invoked from a single active center for the organism. That active center is commensurate with consciousness itself.

A way to understand consciousness as an active center commensurate with itself is to consider conscious focusing. Focusing is not simple, but complex, and involves the whole organism. In gestalt terms, it provides the figure with the non-focused penumbra providing

the ground. Though a visual metaphor, the penumbra should not be understood in terms of sight alone, but in terms of the whole conscious state. Focusing is selective. When any other conscious operation takes the lead it provides the focus which transforms the state of consciousness and the penumbra. This is a transformation of context. The ancillary operations immanent in the achievement of a conscious act are readied. For example, when we try to understand something, the imagination is immediately transformed without our doing anything.

We can conceive of animal behavior as a set of performances enabled by motivational cycles. This allows us to conceive of freedom for the animal within the context of specific operational situations constituted by “drives”, such as mating, hunting, playing and so on. The more primitive the animal, the more cybernetic the behavior can appear. It is helpful to understand behavior and aspects of behavior in terms of Lonergan’s distinction between the intelligible but not intelligent and the intelligible and intelligent. The male stickleback, for example, will defend its nest against any red patch, whether it’s a real fish or not. Geese will roll round objects into their nests whether they are eggs or not. These are stereotypical instinctual behaviors with few degrees of freedom. These behaviors can be both too specific and too indiscriminate. Though “error” prone, they were evolutionarily effective since they evolved to deal with ecologically recurrent states versus the experimental states in which their limitations have been revealed by isolating the acts from their natural context.

Freedom within this context is most likely confined to freedom within performance. The animal does not choose its motivational cycle. Rather it performs within its context. This provides a clue that it is like the type of freedom enabled by skills and that the learning that occurs within animal development is like the learning that occurs in the refinement of skills. In Edelman’s terms, the innate ability is conditioned by the primary repertoire. The refinement is via the self-control of the organism in varying its performance in terms of the object or goal. So the hawk controls its dive and adjusts tacitly in terms of the movement of it’s prey. Self-control is immanent in the dive, but it is not self-control in terms of itself. The control of the performance is conscious, but not known, immanent not explicit. It is not deliberate, but only spontaneous. The learning and honing of skills can occur by the successful repetition of the spontaneous performance so that operational memory and its correlative anticipation make the subsequent performances more efficient.

Until one gets to the higher mammals, it is likely it occurs spontaneously within the immediate situation. At its more complex, it can involve novel organizations of actions via trial and error or via insight as in experiments with chimpanzees who need to use objects in the environment to get food that is not directly accessible. But the reorganization of the “self” is in terms of the other. The result is a refined or altered interactive, behavioral structure; or, as in the case of the chimpanzees, discovery of a new way to relate to the other. Minimally we have an instance of conscious control. Immanently it is self-controlling since it is the animal that is performing the operations, but it is not self-controlling in the sense that it has any idea of what it is doing or choice regarding not performing. Instead, it is choice only in the context of the extroverted, performative context.

Two Notes on Objectivity

For the naïve realist the question of experiential objectivity is the issue of distinguishing the already out there now from the already in here now. For the objectivist it is a question of making sure that anything that is the self is not surreptitiously being assumed in the affirmation of what is real. Since the real is independent of the self, affirmation of the real cannot rely on anything subjective. Because neural mapping is operational and the performance is global you cannot map the naïve realist view of reality in the brain or understand the brain as evolving within a context defined in those terms. For example, different senses have different relative importance across species and account for differences in behavior. The eyesight of the eagle versus the dog's sense of smell enable different hunting behaviors. The philosophical issue is that via sensing, the object or the other can be acted on as already out there now and distinct from us, but as intended there is an inadequate distinction between the self and the object as sensed. The quality of the sensed content is dependent on neural processing. Though qualia are subjective, their occurrence is only conditioned via neural mediation, not determined.

So we need to make a distinction. Neural processes are constitutive (in the sense of being part of) of sensitive contents. But since they do not determine their own state, they enable the self-transcendence of the organism in terms of the sensed other. The distinction of this sense of constitution versus enablement allows us to understand how meaning can have neural conditions but not be neurally constituted. We cannot lay out the whole argument, but only indicate the possibility by distinguishing between expression and speech. The mere difference, or nothingness, of signs permits them to be meaningfully arranged, since they are not constitutive of the meaning expressed. Neural processing (along with physiological structures) is constitutive of expression, but it does not determine its meaning. Rather it enables the expression of any meaning we can conceptualize.

Similarly, consciousness as quality is an unmediated immediacy which is self present, but not as a content or operation. If we consider consciousness abstractly, one role it has is to make differences possible. There is a sense in which the differences are simply de facto. For example, two sounds can be different in tone. The neurology can account to some extent for the experience of the two different tones, but it does not account for their difference. The difference simply is. What is conscious as content is dependent on which neural centers are activated. Likewise with what is conscious as the corresponding operations. As conscious, differences just are. Because it is an unmediated immediacy consciousness adds nothing to the field other than its presence. For example, consciousness makes it possible for there to be a field for inquiry which includes the inquiring itself as conscious and as potentially its own intended content. If we consider consciousness only in this abstract role, we end up with the radical self transcendence of consciousness as "nothing" enabling the emergence of self and other for the organism simultaneously, which is the context in which we have come to understand neural architecture.

Resources

Edelman, Gerald M.

Bright Air, Brilliant Fire: On the Matter of the Mind

Neural Darwinism

Wider than the Sky: The Phenomenal Gift of Consciousness

A Universe of Consciousness: How Matter Becomes Imagination

Damasio, Antonio R.,
The Feeling of What Happens: Body and Emotion in the Making of Consciousness

Gilbert, Scott F.
Developmental Biology

Pert, Candace B.
Molecules of Emotion

Goldstein, Kurt,
Human Nature in the Light of Psychopathology
The Organism

Freitag, Michael and Nauta, Walle J.H.,
Fundamental Neuroanatomy