THEORIA ET HISTORIA SCIENTIARUM, VOL. VIII. N 2
Ed. Nicolaus Copernicus University 2008

Ralph D. Ellis

Non-consummatory Motivations: Extropy and “Life wish” in the Self-organization of Emotion

Abstract

On the “enactive” view of the affective life, emotions are barometers of success for organismically initiated efferent action schemas, and not merely afferent (interoceptive) reactions. This active-passive distinction is grounded in self-organizational theory. One implication of this dynamical enaction approach is that complex systems seek to maintain the complexity of their patterns of activity, and avoid lapsing into lower-energy and less complex patterns. Thus non-consummatory motivations such as exploration, play and nurturance can be seen as resulting from what I call an “extropic” dimension of complex dynamical organisms, and are not as easily explainable as are consummatory motives purely in terms of energy-efficient homeostasis. In consummatory satiation, chemical needs such as in hunger or thirst are the driving forces, pushing toward consumption of chemical resources needed for homeostasis. But homeostasis can be achieved at both higher and lower energy levels. “Extropy” is the tendency of some complex self-organizing systems to prefer higher- over lower-energy basins of attraction. The latter, however, can be convenient paths to energy-efficient homeostasis within component subsystems, which is the driving force of consummatory needs. Extropic motives differ from the purely homeostatic ones — i.e., those which seek a maximally energy-efficient homeostasis — in that the extropic ones resist the complacence that would follow from consummatory satiation if energy efficient chemical balance were the only ultimate aim. Non- consummatory motives, while maintaining homeostasis, can fundamentally conflict with consummatory ones by pushing toward higher-energy attractors in the interest of maintaining complex structural patterns for the overall system. Thus it is argued that extropy is an independent demand alongside homeostasis. This analysis yields an analysis of a number of relatively independent emotional-motivational categories around three main types of needs: Extropic, homeostatic, and boundary-protection needs, conceptualized around the basic dimensions of complex dynamical systems.
Key words: Emotion, motivation, reductionism, self-organization, dynamical systems,

play, exploration, homeostasis

Intertheoretic reduction in the sciences, the view that psychological and biological processes are ultimately explainable in terms of atomic-level chemical and physical processes, does not automatically entail what I shall here call a “microreductionist” approach to motivation and emotion — the notion that all motivations are ultimately reducible to the effects of a thermodynamic energy- consumption system that could be equated on the psychological level with primary consummatory drives. Self-organizational processes involve causal dynamics that are not confined to the effects of the micro-constituents of the complex system. Part of the importance of this point is that science does not demand rejection of humanistic and existential suggestions that some primary or intrinsic motives seek to *avoid* the complacence and stagnation in which all motivation would ultimately revolve around the achievement of a maximally energy-efficient homeostasis of micro-processes, and thus of mere comfort or satiety, with the latter explainable presumably in terms of the energy consumption demands of the organism. I shall refer to the postulated non-satiation-driven primary or unconditioned motives as “non-consummatory” ones.

Such non-consummatory emotions and motivations do not contradict the possibility of intertheoretic reduction in the sciences, from psychology all the way down to thermodynamic chemistry and subatomic physics, although they do require a theory of self-organization in complex systems for the comprehension of their physical basis. My thesis is that not only do complex self-organizing systems seek homeostasis (which already entails “negentropic” as well as entropie functions), but moreover they also sometimes seek “extropy,” which I define here as a positive preference for higher-energy over lower- energy basins of attraction, even in many instances where either type of basin could serve the purposes of homeostatic energy-efficiency equally well. Exploratory, play, social bonding and nurturance systems in the brain are correlated on the physiological side with the “extropic” tendencies of complex systems, and on the phenomenological side with an endogenous and unconditioned tendency toward increased intellectual and emotional stimulation (up to some optimal point), and at the most complex human level a need for existential meaning, i.e., for the experience of the value of being *per se,* whose achievement in humans is sought through personal relationships, ethical values, and meaningful life activities including creativity. This need to experience being as valuable, or in more mundane terms the need to feel inspired, is not unique to humans, but is continuous with the playful curiosity of cats and the dogged persistence of dogs, which resist the lethargy and inertia that such animals show when depressed.

The problem here is to reconcile viewpoints that have tended to be at cross-purposes. On the one hand, hard scientists want to reduce everything to chemistry, which makes consummatory-drive reductionism attractive as a convenient way to connect thermodynamic energy systems with the biological systems that give rise to our emotions and motivations (see Kriegel, this volume). On the other hand, there is the phenomenology of life experience, which seems to call for a richer system of motivations and emotions, to account for the preference for kinds of meaning that do not seem reducible to the satiation of the thermodynamic bodily system's needs for energy consumption, such as getting something to eat or drink (see Cogan, this volume). I believe the notion of selforganization in complex systems can reconcile these two antitheses in such a way that the advantages of both can be preserved. On the humanistic side, human emotions need not be reduced to a complex system of means toward the end of satisfying simplistic consummatory needs. And on the hard-scientific side, the ideal of intertheoretic reduction can be maintained, at least as a way to open the possibility of dialogue between disciplines focusing on different levels of organization, so that different sciences and other disciplines concerned with human consciousness and emotion are not condemned to work in isolation or at cross purposes to each other.

Intertheoretic Reduction and Consummatory-drive Reductionism

Human emotion and motivation have been viewed in notably divergent ways by the hard sciences and the humanities during the past century. That a placid, cud-chewing way of being is not the optimum for humans has been emphasized by literature and the arts, which have cross-fertilized with humanistic and self-actualization psychology and phenomenology, and are substantially congruent on this point with the ego psychologists, the object relations theorists, and the later Freud (beginning with *Beyond the Pleasure Principle').* According to Freud, there must be some instincts that tend to resist the attainment of satiety, because in his view consummatory satiation resulted literally from the energy-consumption rather than the energy-expenditure needs of the organism, and in his later years he saw serious problems with reducing all motivation to the energy-consumption needs. He therefore sought to conceptualize some drive or instinct whose tendencies would run contrary to the purely satiation-driven instincts, which result from the chemical tendency to move toward what Freud loosely called “inertia” (1925/1959, p. 68) - a maximally energy-efficient homeostasis. Part of the problem he saw with thinking of all behavior as in the service of consummatory satiation is that, in principle, if the energy-consumption demands were the only ultimate motives, yet had been met, then the organism would not be motivated to do anything. Another aspect of the problem was that to make complete satiation the goal would lead toward a condition in which “the aim of all life is death” (Freud, 1925/1959, p. 70).

Freud means this aphorism literally. If a system were driven only toward the relative electrostatic stabilization of the molecules in successive steps in the energy-consumption phase of its various feedback loops - toward Freud’s “inertia,” a state of satiety and restfulness where the organism is not motivated by any further need - then the real motive of the satiation phase of nervous activity would be to minimize free energy, i.e. to satisfy each molecule’s demands for electrostatic free energy reduction, insofar as possible given the initial structure of the system with its requirements for homeostatic balance in and between its interconnected chemical feedback loops.

For example, when hydrogen reacts with chlorine to form HC1, the driving force is that the lone electron in the outer electron shell of the hydrogen atom tends to reduce its energy level by filling the lower-energy space available in the outer electron shell of the chlorine atom. By sharing the electron, both atoms reduce their energy level. Metabolic processes are built up from chains and loops of these electrostatically reductive reactions. The consummatory drives thus seem to be motivated by a need to consume energy to fuel this more basic free-energy reduction process.

To be sure, it would then be up to the organism to avoid entropy, by replenishing the energy thus consumed, spending part of it in activity designed to appropriate still more energy. But, as far as the satiation of consummatory drives is concerned, Freud realized that the most efficient way to achieve a completely sated condition with fulfillment of all chemical demands within the drive system would be suicide. A dead person’s drives have all been reduced, and all the chemical components that were pushing the system to reduce their free energy have done so quite effectively. Thus Freud, like many other humanists, looked for a way to conceive of some sort of emergent *elan vital* or life force, some principle of self-actualization or primary drive toward inherently self- motivated activity that would make it intrinsically rewarding for the organism to counteract the tendency toward submolecular free energy reduction and thus entropy, as opposed to relying on intrinsically unrewarding behaviors for this purpose. The later Freud thought he had found such a principle in the sexual instincts, although earlier he had tried to view sexual desire in purely consummatory terms.

Freud was well aware that consummatory satiation does not lead to a reduction in the total amount of free energy within the organismic system, but just the opposite. It leads to a consumption of energy to be stored for future use. He continually refers to the concept of homeostasis, the balance between energystorage and energy-expenditure functions. But he also saw that homeostasis is usually meant as the most *energy-efficient* way possible to maintain balance between the forward and backward reactions of all its interrelated feedback loops - and this implies that the homeostatic balance is maintained with the lowest possible level of energy expenditure necessary to obtain the new energy needed to meet the organism’s energy-consumption needs. This continual push toward energy-efficiency in the sense of gravitating toward a minimal energy level is what led to Freud’s notion of the “death instinct,” which he thought needs a countervailing force — such as his new way of conceptualizing *eros* as a drive toward increasing the energetic activity of the organism — to postpone the final entropy of death.

By contrast to this notion of an *elan vital* that would strive to counterbalance Freud’s “death instinct,” modern physiology and empirical psychology have tended toward an opposite view, which I shall call “micro-reductionism” (see also Ellis, 1995). According to this viewpoint, the only ultimate driving force of organic processes is the same as for inorganic ones — the tendency to reduce the free energy of the most basic constituents of the system, its atoms, as much as possible given the initial structure of the system with its various feedback loops. This tendency is reflected in the electrostatic interactions of the molecules in the system, and its ultimate net result is a tendency toward homeostasis — the push toward a maximally energy-efficient condition that corresponds to Freud’s “death instinct.” The inorganic chemistry principle that all atoms seek to reduce the free energy of their electrons is what would render possible intertheoretic reduction in the sciences (Bickle, 1988), if indeed such an ideal is possible. But to make this free energy reduction principle the only explanatory principle — the approach that I am calling “micro-reductionism”— is to ignore the effects of self-organization in complex systems, which will be discussed more extensively later in this paper. Self-organizational effects are among the most prominent features of biological organisms (Kauffman, 1993; Monod, 1971).

Even the nervous system itself is often explained in micro-reductionist terms as governed by a free energy reduction principle. For example, the tissues of a frog or eel respond electrically (Restak, 1984, pp. 30ff; Ornstein and Thompson, 1984, pp. 77ff), showing that the interactions of their molecules are governed by the tendency of their atoms to gravitate toward electrostatic free energy reduction. Long chains of molecules acting to move closer to neutrality by passing off spare electrons in this way to neighboring molecules constitute nervous impulses, whose ultimate driving force is the submolecular tendency toward free energy reduction.

It is against this micro-reductionism that I wish to argue here — not against intertheoretic reduction in the sciences *per se.* My point is that even the most rigorously scientific accounts of the biological organism lead to a richer system of emotions and motivations than the consummatory-drive reductionism that to many motivational theorists would be suggested by a tendency toward maximal energy-efficiency of the organism’s non-consummatory behavior. I take behaviorism and other learning theories that posit consummatory needs as primary to be classic examples (Hull, 1952; Spence, 1956). These theories explain rewards that are not “consummatory” (in the sense of allowing the organism to consume energy needed for maximally energy-efficient homeostasis) by relegating the non- consummatory rewards to the status of secondary reinforcements learned by association with the primary consummatory ones. And what cannot be explained in this way as learned behavior is simply presumed to be explained by the longer- term “learning history” of natural selection — but again with behavior that favors consummatory drive reduction automatically assumed to be the determining factor. If the characterization I am sketching here of micro-reductionism sometimes sounds like a caricature, it is only because the most extreme versions of micro- reductionism bring out its motivational implications all the more sharply.

Micro-reductionism favors the reduction of negentropic processes to more basic entropic ones at a lower level of organization. “Entropy” is usually defined as a thermodynamic system's tendency toward randomness; but this randomness itself is a corollary of free energy reduction. Thus entropy itself can be defined in terms of the tendency of electrostatic interactions to occur that bring the atoms and molecules of the system to their lowest possible energy level; the electrons of the atoms are brought to the innermost available electron shell, where the electron is required to expend less energy to remain, as in the hydrogen-chlorine reaction resulting in HC1. Not only is intertheoretic reduction committed to this view, but molecular biologists have been fairly successful in explaining the interactions of molecules in terms of inorganic oxidation-reduction and other such electrostatic energy-reductive chemical reactions (see Baker and Allen, 1968; Campbell, 1987; Monod, 1971).

According to the micro-reductionist account, the satiation of consummatory drives is explainable in terms of such submolecular electrostatic free energy reduction mechanisms, even though the overall effect of these drives (e.g., hunger) is to cause the organism to act in ways that continually *increase* the energy available to the system. This may seem like simply an incoherent claim to those not accustomed to reducing organic processes all the way down to their lowest chemical level. It may seem that the paradigm reward activity is to eat, which *increases* rather than *reducing* the free energy within the system, by converting the energy into ATP. But the microreductionist explanation is that the ATP reaction itself is composed of successive steps of chemical reactions, and each of these steps is caused by the tendency of the atoms of the molecules to reduce their free energy, which in turn leads to each successive step. The overall effect for a complex organism is not to incline it toward complete *entropy*, but only to incline it toward the *lowest possible expenditure of energy necessary* to maintain a homeostatic balance between its endergonic and exergonic reactions. In thermodynamic terms, whether energy is consumed or acquired in a thermodynamic reaction depends on whether the reaction is endergonic (resulting in an energy gain for the system) or exergonic (resulting in an energy loss or reduction of free energy). In the Krebs energy cycle that animals use, like every respiratory cycle, and every inhibitory feedback cycle in general, it is initially the tendency for unstable chemicals (e.g., ions) to seek reduction of the free energy of atoms by getting their electrons into more stable energy shells (e.g., neutralization of ions) - an exergonic reaction — that gets the process going. But then, because of the way the system is organized, this leads to further reactions whose end result is that more potential energy is *harnassed* for the system ("endergonically") by converting ADP to ATP (whose phosphate bonds are very easily broken; this is why ATP has so much potential energy). To fuel the process, of course, the organism must continually engage in food-acquiring behavior. But this "negentropic" behavior's purpose, presumably, is to feed the entropic phase of the cycle, whose rewarding quality can be explained through reference to the demand of the micro-components (atoms) for free-energy reduction.

The net result of this whole cycle of activity is a continuing harnassing of energy captured from food sources in the form of ATP. Yet each step of the reaction is driven by the tendency for that step to reduce free energy by getting electrons into less energetic electron shells by means of electrostatic free energy reduction. And this implies that, in net terms, the acquisition of new energy to fuel the reactions will also be carried out as energy-efficiently as possible, i.e., at the lowest energy level compatible with the homeostatic balance between endergonic and exergonic reactions. Thus everything is derivative from the principle that "As electrons are transferred they fall from higher to lower energy levels....The drop in the potential energy levels of the electrons is the energy- releasing mechanism." (Baker & Allen, p. 110-11). Or, to quote another standard textbook, "As a reaction proceeds toward equilibrium, the free energy of the mixture of reactants and products decreases....To move away from equilibrium is nonspontaneous; it is an endergonic process that can occur only when an outside energy source pushes the reaction 'uphill'" (Campbell, 99-100).

At the same time that the whole metabolic process is driven at each step of its reactions by a tendency to seek free energy reduction at that step, and attempts at each step to move closer to equilibrium, the process cannot be allowed to reach equilibrium, or else the whole system would collapse into metabolic stagnation, and thus die. This does not happen because the ATP and other terminal products are continually used up to fuel further organismic activities, other chemical reactions that are outside of the metabolic loop. It is assumed that natural selection has favored the survival of organisms that happened to be structured so that some of the energy diverted from the ATP cycle is used to fuel food-acquisition activity to replenish the cycle to prevent entropy or death.

This micro-reductionist account is perfectly consistent with the fact that no bodily system can ever reach the state of equilibrium toward which the free energy reduction tendency would lead if unimpeded. On the micro-reductionist view, this is because there are loops of reactions in which one chain of steps, each pushing toward maximal free energy reduction in its components, is inhibited by reactions engendered by some of its own products. Also, movement toward equilibrium in one subsystem is opposed by that of other subsystems.

The most energy-efficient level at which all these loops and subsystems can be held in balance is usually defined as homeostasis. Homeostasis results when the forward chemical reaction in a feedback loop is balanced with the reactions in the opposite direction, so that the loop cannot collapse into entropy at either end of the loop. The same result is obtained when opposing subsystems reach this balance. Opposing chains of reactions, whether in different parts of a feedback loop or in different subsystems, are halted in their movement toward entropy at just the right point to maintain a constant cycling of reactions. In order to maintain homeostasis in any system or in the organism as a whole, the organism must behave in such ways as to input the right reactants into the system at the right times. (The organism of course allows for some flexibility in meeting these needs by providing numerous shunt mechanisms in its feedback loops.) Behavior is therefore prompted by a deviation from homeostasis. If there were no possibility of any deviation from homeostasis, then on the micro-reductionist account there would be no behavior.

So the fact that the organism must behave so as to continually achieve “negentropy” does not contradict the micro-reductionist’s motivational assumption that the satiation or consummatory phase of the cycle is literally an energy consuming reaction, in which the micro-constituents in the system - the atoms - are reducing their free energy and moving toward entropy. There must be just enough negentropy (and no more than necessary) to maintain the most energy- efficient possible homeostasis. Micro-reductionists thus tend to assume that the negentropic phase of the life cycle is not primarily rewarding, but consists of acquisition of further energy sources to fuel the free energy reduction demands of the consummatory drives, whose satiation corresponds to the entropie phase of the entropy-negentropy cycle.

That animals’ natural tendencies toward play, exploration, and curiosity do not seem to fit this energy-efficient paradigm is merely a Kuhnian anomaly in need of further explanation for the micro-reductionist type of theory. It can be handled in several ways - by assuming that such activities, which do not lead directly to energy acquisition, do *indirectly* lead to it, and thus are “secondarily” reinforcing (Hull, 1952); or that natural selection favored organisms with such behaviors, even though they are not intrinsically rewarding (LeDoux, 1996); or that the system simply falls short of its attempts at energy-efficiency, so that the activities in question, which burn energy that was previously acquired, are sometimes necessary for the reduction of free energy since the previously acquired energy must be burned in some way (Spence, 1956).

In sum, according to micro-reductionism, organisms are driven ultimately by a demand for free energy reduction at each step in the satiation phase (which is entropic) within a cycling organism-environment system whose overall effect is to continue replenishing the energy available to the system; the system then again uses up that energy by tending toward entropic energy reduction in the satiation phase of the cycle. Presumably, the consuming of energy, leading to submolecular free-energy reduction within components of the system, and in net terms an energy-efficient level of chemical activity (and thus a lowest-possible energy level compatible with homeostasis) is intrinsically rewarding, and in conscious organisms is experienced as pleasurable. Many micro-reductionists are then tempted to take the next step and adopt a consummatory reductionism as their drive theory, in which the satiation of any primary (unconditioned) drive moves certain parts of the organism’s system (i.e., certain atoms and molecules) closer to the lowest possible energy level compatible with homeostasis, given the structural constraints of the system. On this extreme version of consummatory reductionism, the only primary motivations are the ones that aim to “consume” the resources needed to achieve the satiation of these maximally energy-efficient homeostatic conditions. Except for acquired secondary reinforcements, the organism would not behave at all if the consummatory drives were completely satiated. It is this step that Freud was reluctant to take. This is why Freud believed that, in the absence of some contrary, non-consummatory kind of drive, all life would be dominated ultimately by a “death instinct.”

The Notion of “Extropy”

But there is another variable that this discussion of electrostatic reduction has not yet accounted for. The whole system can continue its energy-harnassing and energy-reducing cycle either *very close* to the equilibrium point (where very little energy would be harnassed, but also very little would be used), or it can veer *very far* from equilibrium, while continuing the same homeostatic cycle. How far the system tends to veer from equilibrium while maintaining homeostasis is determined not by the fact that each step seeks electrostatic reduction, but by a property of the overall *structure* of the system, with all of its interrelated feedback loops and embryological tendencies to develop and maintain such structures. It has now been suggested by some theorists of the self-organization of dynamical systems (e.g., Kauffman, 1993; Alexander & Globus, 1996; Anderson & Mandell, 1996) that these structural properties can create “constraints” on the possibilities open in terms of electrostatic reactions at the lowest level of organization. The constraints do not change any of the principles of the way the electrostatic reactions occur, but simply constrain the *initial arrangement* of feedback loops that determine whether a given reaction will be inhibited, catalyzed, etc. at a given point in the cycle.

The possibility that homeostasis can be achieved at either lower or higher energy levels can lead to a further principle, independent of the instrumental need for “negentropic” acquisitive behavior, which in this paper I am calling “extropy” - a motivational tendency that operates in conjunction with electrostatic reduction within homeostasis, but which can sometimes conflict with the movement toward reduction of free energy at any given step of a reaction. Extropy would therefore conflict, in some instances, with the tendency to satiation of electrostatic needs toward which subsystems at lower levels of organization are trying to pull.

“Extropy” as I am defining it here is not reducible to mere “negentropy.” Even consummatory satiation requires negentropic activity of the organism to replenish its consummatory energy supplies; otherwise, it would not get the consummatory satiation. Indeed, all organismic processes, whether consummatory or not, involve negentropy, which is completely explainable in terms of relationships between micro-components by means of traditional thermodynamic concepts. The negentropic activity is geared toward maintaining homeostasis between energy consumption and energy replenishment. But what I want to suggest is more — that *some* organismic processes in *some* organisms (e.g., as discussed below, in mammals at least) involve an additional principle, which is what I am calling “extropy.” The point is that homeostasis can be maintained at various alternative energy levels and degrees of complexity, which correspond to various alternative basins of attraction (some higher-energy and more complex than others). Extropy is the preference for the higher-energy, more complex ways of maintaining homeostasis over the lower-energy, less complex ones. If there ever is such a tendency in complex systems, it would not be reducible to mere negentropy, because an organism can maintain homeostasis equally well at greater or lesser levels of extropy, and all of those ways of maintaining homeostasis involve negentropy. Consummatory as well as non-consummatory motivations involve negentropy, which is necessary for homeostasis. But as I shall argue later in agreement with Panksepp (1998), only behaviors like seeking, curiosity, play, and some aspects of social bonding are motivated by a tendency to prefer maintaining this homeostasis via higher energy basins of attraction by preference over lower energy ones — i.e., even when the behavior is not indirectly reducible to the consummatory needs.

Consummatory and non-consummatory motivations thus can be thought of as different ways of maintaining homeostasis — the consummatory ones being motivated toward basins that are at the lowest possible level of energy necessary for replenishing the energy needed for the tissue satiation; the non-consummatory ones are at basins that are at a higher energy level than necessary for that purpose. "Consummatory” motives can be thought of as motives whose gratification involves replenishment of energy for consumption within organismic tissues. Non-consummatory motives then would be the ones that involve energy expenditure *not* for the purpose of replenishing energy for consumption by organismic tissues. E.g., animals do not play in order to replenish energy consumed by tissues within the organism in a way necessary for homeostasis Panksepp, 1998). They seem to be motivated to play, i.e., burn energy, essentially for the joy of doing it, even though it does not necessarily lead to replenishment of energy consumed by bodily tissues (e.g., acquiring food). I.e., it is not necessary, for the purpose of maintaining homeostasis *per se,* to engage in all of the high- energy activities involved in play, pure exploration, etc.

To be sure, an extropic emotion may be triggered by a homeostatic imbalance. The hypothalamic-brainstem system serves to monitor such imbalances, which serve as signals that the organism’s total self-organizing system may be deviating from the preferred overall patterns, including the preferred degree of extropy. For example, when the body has been sleeping (i.e., settling into a very low- energy basin of attraction), norepinephrine (NE), dopamine (DA) and serotonin (5HT) imbalances will eventually be triggered by a brainstem mechanism Panksepp 1998, pp. 109ff) and will signal the brain that some action should be taken to get the body aroused (i.e., into a higher-energy basin). This signal occurs in the form of a homeostatic imbalance, but the reason the imbalance occurs in the first place is that the whole bodily system has settled into a low-energy basin for too long to allow its definitive holistic pattern to be maintained without a change of energy level; the holistic need to shift into the higher-energy basin then leads to the homeostatic imbalance in the subsystem of the brainstem. The brainstem subsystem is really acting as a barometer for the total dynamical system’s need to maintain its structure by reorganizing its micro-components into a higher energy basin.

Some organisms are structured so as to crave more extropy than others, even though homeostasis could be achieved with less extropy. A three-month infant will begin to explore its environment in some minimal ways even though its needs for comfort, security, and nurturance could well be met by simply continuing to eat and sleep in the same pattern that served it so well for the first three months (Thelen and Smith 1994). During these first three months, the homeostatic needs were served at a very low level of extropy. But at a certain point, maturation leads to new patterns of brain organization in which the thalamus is triggered to sense that something is wrong if there is not enough exploratory activity. Here again, although the signals that indicate the disturbance are the immediate results of homeostatic imbalances within a subsystem - the hypothalamic-brainstem subsystem, which senses the chemical results of too little brain activity, the craving for more brain activity would not need to be there in order to serve the purposes of homeostasis.

Another way of looking at this point is to remember that the demands for extropy do not contradict the organic- and ultimately inorganic-chemistry principles that govern the micro-components of the system. The system is merely structured in such a way that it often prevents the fulfillment of energy reduction for the micro-components except by means of a settling into different basins of attraction at different energy levels, and systems that are structured in very complex ways make it impossible to achieve homeostasis in a subsystem without seeking a higher degree of extropy than the one that happens to obtain at the time. So the failure of homeostasis in one subsystem — the hypothalamic- brainstem neurotransmitter system — may signal a failure of a suitable degree of extropy for the entire organism.

As another example, a person on vacation might find it quite pleasant to just sit around and eat cookies for the first few days. At some point, the hypothalamic- brainstem subsystem will alert the organism that something is off: there is too much energy being consumed and not enough being used. Here again, the signal for this condition is that increased dopamine, norepinephrine, and other activity- inducing neurotransmitters are released. The organism wants to exist at a higher energy level. But the interesting point for our purposes is that some types of animals will reach this point earlier than others, because their organisms are structured in such a way as to demand extropy more frequently. Cats can sit around for hours doing nothing — a feat that is very difficult for a fully awake human. It is not that any organism wants extropy merely as a means to the end of homeostasis; rather, some organisms want extropy for its own sake more than others, even though homeostasis can be achieved at many different levels of extropy. So the fact that a failure of extropy may be signaled by a homeostatic imbalance should not be taken as implying that extropy is only a means toward the ultimate end of homeostasis. Extropy is the demand to find homeostasis by means of various different basins of attraction reflecting various different energy levels.

It is also true, of course, that natural selection *favored* organisms with seeking systems and other extropic tendencies, for at least three main reasons: (1) Such organisms are more likely to find food in the course of their extropic seeking activity. (2) Such organisms are likely to be more intelligent because of their curiosity and seeking orientation. And (3) they are likely to learn things incidentally in the course of their play and exploration that will help them survive.

But the fact that extropically-orientated behavior may have provided a selection advantage does not erase the fact that, for the individual organism, extropic behavior (play, seeking, etc.) is not derivative from consummatory motivations by means of reinforcement of primary consummatory drives, which would make the extropic behavior into a mere secondary reinforcement. On the contrary, the extropic behaviors seem to be *primarily* reinforcing in organisms at our evolutionary level. I.e., they are reinforcing regardless of whether they are necessary for us to maintain energy-efficient homeostasis, or even the best way to do so. They are *one* way of maintaining homeostasis, while at the same time satisfying a primary motivation to maintain the homeostasis at a suitably complex and high-energy basin of attraction.

It is all too often tacitly assumed that negentropy is the highest level of organismic activity that is compatible with the lowest level of scientific explanation, i.e., the inorganic-chemistry/subatomic-physics level, and therefore that anything that does not fit that level of explanation is unscientific. Since the existence of negentropy in the behavior of organisms can be explained by positing that it consists of merely instrumental behaviors in the service of primarily *consummatory* motives, micro-reductionists of the Twentieth Century tended to assume that the notion of a primarily non-consummatory motive is incompatible with a scientific understanding of how our systems work. They assume that all behavior is explainable as derivative directly or indirectly from consummatory motives, and that no other type of motivation is consistent with our understanding of the lowest level of scientific explanation. Thus those who are prone toward the ideal of intertheoretic reduction in the sciences often want to think that all apparently non-consummatory reinforcements are only *“secondary”* rein-forcements, learned through reinforcement of *primary* drives, which are con-summatory.

It is true, of course, that one way to respond to micro-reductionism here would be simply to deny that intertheoretic reduction in the sciences is possible. But my point is that it is not necessary to deny this in order to establish that some behavior is primarily non-consummatory. One advantage of leaving open the question of intertheoretic reduction is that, when accounts at one level of science can be made at least compatible with what is going on at another level (even though this is not always possible — e.g., quantum theory does not seem compatible with relativity theory), our understanding at both levels is often enhanced. The explosion of biochemical manipulation of behavior and affect is an example of such intertheoretic bridging, although of course the appropriateness of the practical application of such treatments must always be carefully evaluated.

It is important to notice that extropy is an additional tendency beyond mere homeostasis *via* negentropic behavior, the latter being geared only toward replenishing the minimum amount of energy needed for the energy consumption demands for maintenance of organismic functioning. This maintenance of homeostasis in itself can be accomplished at higher or lower energy levels, and some organisms are organized in such a way that they prefer to do it at the higher energy levels a good percentage of the time. And, even in these organisms, there are ups and downs, where we sometimes feel a need to pull ourselves out of the lethargy of too much dull comfort, even though the dull comfort itself might be quite homeostatically satisfying. But this point also needs to be compatible with what we think when we put on our "scientific" hats.

Within the respiratory energy cycle, there can be lengthy digressions (as in primates) where huge amounts of energy are diverted to other purposes, and then replaced by making more ATP later; or there can be fewer digressions (as in lower animals and plants), where less energy is diverted to other purposes, and so less energy *needs* to be replaced by making more ATP. Thus animals, for example, need to use aerobic respiration to fuel all these additional energy digressions, whereas plants can use anaerobic respiration, which is much less efficient, but perfectly adequate for plants, because they need less energy for other purposes. Plants remain closer to equilibrium than animals, and we primates deviate further away from it than lower animals. What extropy is explicitly opposed to is not homeostasis, but simply stasis *per se.* It could thus be argued that extropy must introduce considerable complexity into a system to counteract a tendency to settle into conditions too close to equilibrium.

Many theorists would be content to grant that extropy is opposed to energy-efficiency, not because there is an independent extropic tendency in very complex dynamical systems, but simply because natural selection, operating separately from the mechanisms and motives of any individual organism, created conditions favorable to the survival of beings whose subsystems just happen to inhibit each other's basic aims, so that such systems would be forced to subsist in a state very far from equilibrium. For example, such a view might agree with Schopenhauer (1956) that it would be better from the standpoint of the individual organism if sexual satisfaction could be attained without the complexities of courtship, bonding, and commitment to offspring, but natural selection has engineered our bodies in such a way that we cannot get the personal satisfaction desired except by making certain individual sacrifices in the interest of the species. I.e., we are structured so that we have to do things contrary to our individual motives in order to get what we want - the satiation of our consummatory needs.

But this kind of "just so" explanation leaves many unanswered questions about *how* such systems could ever come about - what its tangible mechanism is. In a similar way, we might explain how a certain pitcher throws an extremely effective knuckle ball by pointing out that he would not have survived in the Major Leagues without a good knuckle ball. At a certain level of theorizing, this is true, but it does not explain the real mechanism of the knuckle ball. It is at this more tangible level of explanation that the theory of complex dynamical systems is needed for an understanding of extropic motivational tendencies that are not reducible to energy-efficient homeostasis alone.

Such an independent principle would seem to call for a further dimension of motivational explanation besides consummatory reductionism. Even though consummatory reductionism allows that there can be an overall gain of systemic energy through endergonic reactions and feedback loops, and that complete equilibrium is always unattainable (until the system dies), it still holds that at each step the system is only doing whatever it can to move as close to equilibrium as it can — somewhat like a donkey chasing an unattainable carrot that has been permanently dangled in front of its face. Systems presumably push, in net terms, toward the lowest energy level compatible with homeostasis. If there is an extropic principle, it would oppose or counteract the tendency to reduce free energy, by allowing the system to be driven not only by components outside of the system as they pursue their own exergonic aims, but also by the extropic structure of the system itself, which causes it to go out and actively seek to appropriate components that can serve to maintain it.

This notion of extropy opens questions that we must now try to answer. How can it be linked to motivation and emotion at the phenomenological level? How can it be grounded in specific neurophysiological findings, and at the same time integrated into a plausible and applicable scientific theory of self-organization in complex systems? To move first toward an answer to the first of these questions, let’s return momentarily to Freud’s “death instinct” problematic.

Extropy and the “Life Wish”

From 1925 Freud sought a principle very similar to what we are calling “extropy,” and expressed increasing doubts about the possibility of explaining all drives as derivative from the tendency toward free energy reduction in the electrostatic behavior of the chemical components of the organism. Freud regarded the sexual instincts as anti-reductive in the sense just mentioned:

> The sexual instincts ... operate against the purpose of the other instincts, which leads, by reason of their function, to death; and this fact indicates that there is an opposition between them and the other instincts.... One group of instincts rushes forward so as to reach the final aim of life [i.e., death] as swiftly as possible; but when a particular state in the advance has been reached, the other group jerks back to a certain point to make a fresh start and so prolong the journey (Freud, 1925/1959, pp. 74-5).

The behavioral and motivational tendencies that Freud speaks of here (sexual "instincts”) occur at a higher level of organization than the chemical reactions that make up the system. Even though each reaction seeks to minimize free energy at that particular step, the complexity of the system's organization can sometimes oppose this aim in net terms, and can seek to settle into higher energy basins of attraction by preference over lower-energy ones. The organism can then prefer energizing, exploratory, or playful behaviors over those that would lead to consummatory satiation and rest; and it often shows this preference even when we are tired or hungry, as during the grueling last quarter of a football game. If the very structure of a suitably complex system favors extropy in this sense, then exploration, play, nurturance, and other non-consummatory pleasures are primary reinforcers, not derivative through learning from the purely consummatory drives.

Otto Rank (1924) and Rollo May (1969) developed this view more fully in terms of what Rank referred to as the "life wish" and the "death wish," with a correlative "life fear" and "death fear," whose conflicting tendencies make for the more existentially meaningful aspects of the emotional life, such as a desire to explore, to create novelty, and to actualize the more interesting potentialities of the self even if at the expense of considerable discomfort or pain. Abraham Maslow (1974) consolidated and popularized what we might term this "anti-consummatory-reductionist" way of thinking by positing two entirely different motivational tendencies, the "deficiency" motivations and the "actualization" motivations — the latter resulting from the expression of self-organizing tendencies in an explicitly neo-Aristotelian sense. Maslow credits Aristotle with the insight that "pleasure" is not always a matter of consuming something (filling a "deficit") or achieving any end state, but rather can be enjoyed as an active and self-motivated process of expressing the natural tendencies of one's own pattern of being, even if at the expense of the reduction of consummatory drives.

This antithesis builds on Robert White's definition of a drive as a "physiological deficit external to the nervous system, and perceived by the nervous system as noxious" (White, 1959, p. 298). For Maslow, not all motivations are driven by "physiological deficits external to the nervous system" nor by the fear of any form of "noxious" outcome. White's view may be still more extreme: His argument is that the notion of a "non-consummatory" drive makes no sense by this definition of "drive"; if a drive refers to a deficit external to the nervous system, then all drive-reductive motivations are "deficiency"-driven in Maslow's sense. Thus the notion of a self-actualization motivation could consist only of a non-drive-reductive tendency *per se* — in a sense, an even more radical notion than Maslow's.

White's definition of "drive" highlights the tendency of consummatory reductionism to think of motivations and emotions as arising from the organism's needs. The needs in turn are for ways to rectify a bodily situation that has moved too far from equilibrium. Without food, for example, there is nothing to fuel the Krebs energy cycle, and as a result, its initial reactants and final products are too far from equilibrium. The reaction wants to proceed in the forward direction, and there are no inhibitory products at the other end to push in the backward direction. The “deficit” involved is a deficit of something that could help the system move closer to equilibrium, even though complete equilibrium can never be reached, since some of the terminal products of the energy cycle would be directed for other purposes than to inhibit its initial step.

The humanistic attitude toward consciousness and emotion has regarded drive-reductivism as inadequate to address the complex moral issues and questions about ultimate meaning that conscious beings face — not because there is so much more yet to be learned about the various ways that “basic” emotions can be mixed and modified, but because if the “basic” emotions themselves are consummatory-drive reductive in the sense just discussed, then in principle no non-reductive tendency can ever be *derived from* them. Humanism also has tended to shy away from equating consciousness in general with its physical substrata, because folk psychology, like phenomenology, suggests that empirical observations alone cannot tell us what it is like to experience another’s consciousness directly (Husserl, 1913; Ellis, 1986). This principle was later discovered by analytic philosophers of mind under the title “the knowledge argument” (Jackson, 1986): If consciousness were literally the same as its physical substrata, then complete knowledge of the substrata should constitute complete knowledge of what the consciousness feels like to its subject; but it does not. How to resolve this problem remains an open question for physicalism, and further reinforces the humanists’ alienation from physicalist accounts of the emotions.

More generally, existential and phenomenological approaches avoid what Husserl (1913) called the “natural attitude”; importantly, Husserl distinguished *intentional* objects in consciousness from *physical* objects in the world that we may theorize to be the *causes* of the brain events that can affect our intentional consciousness. The objects of which we are conscious — i.e., phenomena as they appear to us — are not necessarily the same as the physical objects as they would exist independently of us, and it is quite arguable that they are never the same (Hutto, 2000); yet, according to Husserl, naturalistic physiology and psychology tend to conflate physical and intentional objects, speaking as if it were self-evident that a stimulus “caused” the perceptual consciousness of it, and as if an emotional stimulus simply “caused” an emotional response. The resulting theory made human beings into robots or zombies (Chalmers, 1995) whose responses are merely passive reactions to an input without any causal power attributed to the intervention of subjectively experienced intentional meanings (Jackendoff, 1996; Ellis, 1996a). Existentially oriented philosophers and psychologists therefore tended to gravitate to the view that physiological psychology could never adequately connect with the higher moral and intellectual lives of people, and would inevitably produce pictures of human nature too simplistic and brutish to satisfy the philosophical concern with meaning in life, or to accurately reflect the subtlety and richness of emotional meanings.

In effect, we now have two opposite views of human motivation. The "drive reductive" view, for which physiology and behavioral science have amassed a vast array of evidence, holds that the aims of life are reducible to a roundabout way for the micro-elements of the system to reduce their energy level even though they must inadvertently re-energize the system as a whole in order to do so, and this reduction to the most energy-efficient means of achieving homeostasis is experienced as pleasure or the reduction of pain. What we think of as high-minded ideals are really only twitches of a satiation-driven nervous system. In the consummatory-reductionist scheme, any increase of physiological arousal that is not somehow in the service of drive reduction must be contrary to the real intentional aims of the system, since the latter are only epiphenomena of the push toward electrostatic energy reduction in the ultimate components of the system.

The "self-actualization" view, on the contrary, is championed by ordinary folk psychology, phenomenology, artists, writers, literary critics, existential philosophers, and many practicing clinical psychologists. It holds that we have a fundamental interest in acting in such ways as to pull ourselves out of the dull comforts of consummatory satiation, and that a complete reduction to complacence would lead to an existentially meaningless and amoral somnambulism, a "wasteland" suitable only for T.S. Eliot's "hollow men." Is there a way to reconcile these conflicting viewpoints within a scientifically respectable yet existentially meaningful framework?

A Possible Synthesis

The gap between these scientific and humanist traditions has recently narrowed. Philosophy of mind, for its part, has begun to realize that information processing is not the same thing as consciousness (Chalmers, 1995), and that emotional purpose and agency are essential to "enacting" consciousness (rather than merely "reacting" to input) by driving information processing in terms of the self- organizational structure of the living organism (Varela, Thompson, & Rosch, 1993; Ellis, 1995, 1999a, 1999b; Newton, 1996; Damasio, 1999; and others to be discussed below). Very new physiological evidence that does not reveal the emotions as geared merely toward consummatory satiation (Freeman, 1987; Panksepp, 1998; Watt, 1998; Damasio, 1999) and new philosophical movements within the philosophy of mind, such as the "enactive" movement just alluded to, make possible a reconciliation between the long-diverging paths of physiology and phenomenology. The key to bridging the gap is the concept of self-organization as developed by Monod (1971) and Kauffman (1993) and applied to cognitive theory by Thelen and Smith (1994), Mac Cormack and Stamenov (1996), Ellis (1995), Newton (1996) and others. The idea is that, in a complex self-organizing system, the overall process is organized in such a way as to appropriate and replace its own needed substrata rather than merely being caused by their discrete interactions.

This view has roots in Merleau-Ponty's (1942) notion of psychophysical forms as well as the thinking of developmental biologists in the early twentieth century attempting to understand why an organism imposes its own patterns of organization on the material that serves as its component parts (e.g., see Bertalanffy, 1933/1962). The patterns of organization into which a system tends to settle are called "basins of attraction." Any self-organizing system has a number of basins of attraction toward which it tends, and which one it chooses is determined by the best way to maintain coherence within the system given environmental perturbations. In some instances, given a sufficiently complex system, a higher-energy basin is preferable over a lower one — thus giving the system a tendency not only toward homeostasis, but also toward extropy; if the energy efficiency of homeostasis within a subsystem, or the system as a whole, is allowed to go too far, the system will not deviate far enough from equilibrium at either end of its feedback loops, and the result is death and disintegration of the system (Kauffman, 1993; Newton, 2000). The reason is that, if the pattern of activity that is constantly appropriating and replacing its components can occur only at fairly high energy levels, then these are the energy levels that the system will continually readjust its micro-components and subsystems to maintain. The dynamical systems way of thinking does not disregard the push toward free energy reduction, but adds a self-organization principle to it, as an additional fact that must be accounted for. Discrete causal sequences (Kim's "causal closure") presuppose background conditions, and a self-organizing system is able to rearrange the background conditions so that the overall pattern can be subserved by alternative causal sequences at the micro-level (a kind of multiple realizability where the choice of realizers is determined by the structure of the larger system).

This way of thinking can make sense of Jackson's above-mentioned "knowledge argument," because a self-organizing system acts on its own component materials and on the environment rather than merely passively reacting to them. It is easy to see why one person cannot enact another's self-organizing patterns, and therefore cannot feel the other's sensations or other conscious states even though these may all be observable physical processes. When the scientist Mary observes another person's brain processes, she reacts to them consciously by enacting *her own* brain processes. So the subjective experience that the objective observations reveal to her is what it is like to enact her own processes — not what it is like to enact the other's. Even though this enactment may be completely physical, what it is like is not empirically observable by someone who merely reacts to it. The self-organizing process in this case is not reduced to the sum of the externally observable components, because what it is like to enact such a process may not be observable from an external perspective, given that it organizes its empirically observable components and not just the other way around (Ellis, 1999a, b, 2000a, b, c). The "what it's like" component is the way things can appear only to the system initiating the action commands that are presupposed by any consciousness. The observing scientist also initiates action commands, subserving her own consciousness of what is happening, but these are not the same action commands being initiated by the subject of the experiment. Obviously, not all physical phenomena can be observed from just any perspective. For example, the location and velocity of an electron cannot be observed from the same position. A rainbow appears in full color from one perspective, but only as particles of moisture reflecting white light from another. It may be that even though the components of a conscious system may be externally observable, certain aspects of their complex interrelations can be observed only from within the system. Even empirical observation depends ultimately on the subjective enactment of an experiencer, which itself does not seem to be observable from an external perspective. Yet the subjective enactment can also have some causal relevance, because it is a structural pattern that acts to appropriate its own future micro-components.

A complex self-organizing system appropriates and replaces component elements, not just for the purpose of maintaining the complex homeostasis of its various chemical processes, but in some instances also for the purpose of gravitating toward higher energy basins of attraction by preference over lower-energy basins. Again, this is because maintaining the pattern across multiply realizable components readjustments entails maintaining the energy levels necessary to that pattern. This makes possible a convergence between physiology and views of motivation that are not consummatory-drive oriented, such as those of Rank (1924) and Maslow (1974), who are at pains not to reduce human beings to complacent, robot-like creatures with no fundamental interests beyond avoiding hunger, thirst, and other discomforts. The remainder of this paper will discuss the convergences that are now possible between physiology and these more humanistic and existential approaches to emotion.

Physiological Evidence for Non-consummatory Motivation

Recent physiological accounts of emotion are more sophisticated than the simplistic hedonistic-behaviorist theories of the past. Physiologists of emotion like Panksepp (1998), Watt (1998), Freeman (1987) and Damasio (1999) speak of many physiological emotional tendencies that have nothing to do with the motivation to reduce consummatory impulses — emotions geared toward play, exploration, bonding, empathy, and other non-consummatory activities that cannot be derived from learning based on reinforcement in terms of consummatory drives.

“Consummatory” in this context means oriented toward filling a “deficit" that stands in the way of energy-efficient homeostasis through submolecular energy-reduction. In non-consummatory behavior, there is no prior deficit, but simply the desire to engage in patterns of activity consistent with a complex system’s tendency to maintain an optimal level of both homeostasis and "extropy.” Freud’s concern with this point parallels Kauffman’s later distinction between open thermodynamic systems at the edge of chaos on the one hand, and closed and “frozen” systems on the other: A closed or frozen system moves quickly toward death. As Newton (2000) explains, “In closed systems, isolated from the environment, the group [of entities] eventually succumbs to entropy: the interactions are random and the group is in a state of stable equilibrium - a state that does not change with time. In open systems, by contrast, there are three general possibilities with regard to order. First, the system could become chaotic: the interactions within the system could occur with increasing randomness. The system would eventually reach total entropy, or equilibrium with the environment, and disintegrate because of environmental invasions (such as when a leaf decomposes in a compost heap). When an organism is at equilibrium with the surroundings, it is dead. The second possibility is that the system could be frozen in a single state in which interactions cease altogether (a diamond is such a system). Third, the system could reach a sustained, nonequilibrium state of homeostasis, in which stability of the system as a whole is maintained by means of continual adjustments to environmental perturbations” (Newton 2000, pp. 92-93).

Freud, however, if he spoke the language of dynamical systems, would want to go a step further. He would ask whether all nonequilibrium systems maintain homeostasis with maximal energy-efficiency, or whether some prefer higher- energy basins of attraction over lower-energy ones that are equally capable of maintaining homeostasis. On my interpretation of Freud’s later view, he would prefer the latter alternative.

Panksepp’s research on the physiology of emotion, consistent with the other emotion researchers just cited, suggests that the mammalian organism is organized to self-trigger its own energization mechanisms. “The basic waking mechanisms of the brain do not require sensory input from the body to sustain arousal” (131). Specifically, “[NE, DA, and Serotonin] neurons contain internal pacemaker mecha-nisms to maintain spontaneous activity requiring no incoming influences....Clearly these brain systems control holistic aspects of brain functioning rather than discrete behavioral processes” (109-10). Thus emotions in Panksepp's view intend holistic balance, not discrete chemical reactions or rigid behavioral outcomes. The behavior of laboratory animals may sometiems *seem* rigid, but only when an animal's choices have been artificially constrained to the point of excluding all but one useful behavior for the organism's overall purposes. When Pavlov's dogs' options were continually constrained to this extent, they became "neurotic" (Pavlov's word) and thus "no longer useful for our purposes" (Pavlov, 1929). According to Panksepp, "Psychiatric disorders result from neurochemical imbalances (i.e., lack of regulation) among many transmitter systems as opposed to a pathology in a single one, so there may be many ways to restore overall balance" (117).

Panksepp regards "seeking" as endogenous and spontaneous, not derivative from learning and reinforcement. "The extended lateral hypothalamic (LH) corridor [with ascending DA circuits and descending glutamaturgic circuits]...responds unconditionally [i.e., without any previous learning or conditioning] to homeostatic imbalances....This harmoniously operating neuroemotional system drives and energizes many mental complexities that humans experience as persistent feelings of interst, curiosity, sensation seeking, and, in the presence of a sufficiently complex cortex, the search for higher meaning" (145). Thus there is physiological evidence for the emergence of non-consummatory activity as an intrinsically (as opposed to instrumentally) valued activity of the organism. Panksepp goes on to emphasize that "this is a diametric reversal of traditional behaviorist thinking.... The affective state [that serves as reinforcer in some instances]... is not simply 'pleasure' but a highly energized state of psychic power and engagement with the world"(147- 150). While "pleasure" and "reinforcement" are not synonymous for behaviorists, any behaviorist learning theory must presuppose a distinction between consummatory and instrumental behavior; the non-behaviorist element in Panksepp's system is that there are entire categories and systems of complex behavior that do not involve, even indirectly, any *consummatory* reward.

It is true that Panksepp does not distinguish the homeostatic motives from an explicitly conceptualized extropic dimension thematized in terms of dynamical systems theory. But Panksepp's opposition to behaviorism calls for such a distinction, because without it, the distinction between consummatory and non- consummatory motivations itself remains unclear. This problem will be discussed more completely later on in this section.

To many drive-reductively oriented psychologists and physiologists, especially those committed to intertheoretic reduction in the sciences, it may seem strange that we would be motivated to seek extropy at all. The reason can be stated purely in physical terms, when we realize that all motivated systems have self-organizing structures and are complex enough to prefer higher-level basins of attraction, as aspects of the definitive pattern to be maintained. The fact is that, even if each of our smallest subsystems (e.g., molecules) seeks the lowest energy level compatible with homeostasis, the whole still must be self-maintaining, so that for one system to gravitate toward energy-efficient homeostasis often prevents another from achieving it, and therefore the system as a whole is organized so as to prevent *any* subsystem from completely achieving it. This was the way Rank (1924) and the later Freud set up their "conflict" theories of motivation — i.e., theories in which conflict between the organism's own basic motivations is inevitable. In such conflict theories, what keeps the organism going is that it cannot achieve one set of aims without creating new demands in another.

Perhaps a more up to date formulation would be that, within the context of a self-organizing supersystem, there are phases that the supersystem often shifts into such that the subsystems can reach homeostasis only at a fairly high energy level, and therefore the system has to prevent any of them from settling into complete energy-efficiency. But if everything were dictated by the tendencies that the most fundamental processes normally exhibit when *not* subsumed within a complex dynamical system — the inorganic chemical reactions that make up the organic reactions (e.g., chlorine reacting with hydrogen) — those systems at that inorganic level would seek the lowest energy level compatible with homeostasis. But they could actually reach equilibrium only if operating outside the context of a self-organizing system (Kauffman, 1993).

The conflict between homeostasis and the need for extropy is not *a priori* unavoidable, as it would be if entropy and homeostasis were equivalent terms. But the two tendencies will *often* tend to come into conflict, because the most energy-efficient ways to achieve homeostasis so often tend to be the ones that are most directly micro-reductive, and that enhance a subsystem's proximity to equilibrium — eating, drinking, resting, sexual orgasm, etc.

The play of young animals, for example, consumes considerably more energy than would be consumed by eating, yet with substantially less payoff in terms of any consummatory drive reduction with which the animal could associate the play behavior due to past learning. The desire to play is instinctual, and not contingent on past rewards in the form of consummatory drive-reducing reinforcements such as food or sexual pleasure. It is well established, for instance, that chickens literally would rather peck than eat (Wolfe & Kapłon, 1941). It has also been known for some time that rats will cross an electrical grid for the reward of being allowed to explore new territory (Dashiell, 1925; Nissen, 1930), that monkeys will solve complex problems in exchange for being allowed to look out the window (Harlow, 1950; Montgomery, 1955), and that rats will run on a treadmill for the sole reward of being allowed to press a bar (Kagan & Berkun, 1954).

It is true, of course, that instinctual hardwiring toward playful behavior has a general selective advantage, since many survival skills are developed through play; but the animal does not know this in advance, and thus its playful behavior is not contingent on the rewards that much later will follow very indirectly from the playful learning. The animal values the play intrinsically - for its own sake - rather than instrumentally. One might say that Panksepp's rats operate from a type of enjoyment that is more Aristotelian than modern: For Aristotle, pleasure is taken in the process of actively exercising one's capacities, rather than in the achievement of a static end state. For the athlete, for example, the value of winning is partly instrumental — to provide a game structure to make possible the *playing* of the game, and also to earn the privilege of playing again tomorrow. The athlete not only plays in order to win, but also wins in order to play. The playing activity is valued intrinsically, for its own sake. The same is true for experimental rats, in spite of their considerable domestication.

It is often assumed that emotions are simply reactions to discrete stimuli - that an insult causes anger, which in some sense basically intends behavior automatically geared toward the infliction of injury (unless repressed or sublimated). On the self-organization view, by contrast, the aim of all emotions is to maintain or restore homeostasis at a suitable level of extropy, and the relevance of discrete stimuli is merely that they perturb the organism's *already ongoing* intentions. The behavior of the organism is self-moving, and objects either facilitate or get in the way of that ongoing movement, with consequent adjustments intended to preserve homeostasis within extropy. But it is incumbent on the self-organization theorist to work out the behavioral details of this approach for specific responses like fear and anger. Before getting into those details, however, it is necessary to make the notion of self-organization itself more physiologically concrete.

When the brainstem emotional system, with the help of the thalamus and hypothalamus, registers that the complex self-organizing system of the body has either deviated from homeostasis (for example as in hunger or thirst), or has settled into a state too close to equilibrium (as when the organism has been sleeping for too long), the neurotransmitter nuclei in the midbrain, pons, medulla, and other emotional areas release neurotransmitters that are then propagated along neural fibers to the cerebellum, motor cortex, hypothalamus and thalamus to gear up the brain to command the body to take action (Faw, 2000; Damasio, 1999). Still other brain areas - the amygdala, cerebellar cortex, thalamocortical loops, and supplementary motor area are used to compute what kind of action is likely to be effective in restoring the desired balance (Schmahmann, 1997). For example, disgust motivates the organism to distance itself from the object with the chemical properties that disturb its own homeostatic chemical patterns.

Any sudden environmental change will trigger at least some of these action-oriented emotional responses to a greater or lesser extent (Faw, 2000). But most sentient organisms are structured so that specific kinds of changes will trigger them more than others. In very sophisticated animals, such as mammals, new stimuli can be conditioned to trigger these responses to an extreme extent, and the organism can pre-tune itself to be either hypervigilant or relatively oblivious *to the same stimulus at different times,* depending on subtle environmental contextualizations. For example, the same noise that will trigger an intense fear response for someone burglarizing a house will not trigger any fear for that same person if he is merely a guest in that same house (see Ellis, 2000d).

LeDoux (1996) shows that, when a sudden novel stimulus is presented, the amygdala is the first brain area to get input screened by the thalamus (see also Damasio, 1999; Goleman, 1995). Like the amygdala, the hippocampus is also activated very early after presentation of a novel stimulus, showing enough activity to produce an event related potential at least as early as 18 ms. after presentation of even an unanticipated stimulus (Faw, 2000). The cerebellum also has been shown to be activated at about 20 ms. (Woodruff-Pak, 1997). This subcortical activity occurs long before the visual cortex can determine the identity or specific features of the unanticipated stimulus. Visual processing of a novel stimulus occurs somewhere between 100 and 200 ms. after presentation, and we are not conscious of such an object until about 300 ms. (Coles, 1990; Aureli, 1989). Long before this cortical processing occurs, the amygdala produces a startle response to anything that does not feel either familiar or like “good” novelty.

Notice the important role of the “feeling of familiarity” here. I argued in *Questioning Consciousness* (1995, Chapter 6) that a feeling of familiarity is essential to explicit recognition or recall memory. The amygdala is immediately adjacent to the hippocampus, which is especially sensitive to whether things feel familiar. So a mature, psychologically healthy person’s amygdala will not be startled by something that feels familiar or like good novelty, because the hippocampus always already knows what feels familiar, and the amygdala is primed only to produce the startle response to what does *not* feel familiar (or like good novelty). But a person without good hippocampus training — e.g., someone whose parents’ behavior was so completely unpredictable that they acted playful and loving one minute and brutally angry the next, for no discernable reason — that person’s amygdala will continually produce a startle response to things that are perfectly familiar, because even familiar things are unpredictable. In this person’s infancy, the familiar was almost as likely to pose a sudden threat as was the unfamiliar (Zachar, 2000). The person’s amygdala therefore cannot be discriminating and make use of the hippocampus’s ability to read situations that feel either familiar or like good novelty. We see, then, that when and how a basic anger or fear response will be triggered by a given stimulus is always already contextualized in terms of the dynamical interrelations of various organismic systems operating within a total project of maintaining homeostasis within extropy.

All of the recent physiological observations discussed in this section lend themselves to a self-organizational description based on the often conflicting tendencies toward an energy-efficient homeostasis on the one hand and extropy on the other. In the normal course of experience, contrary to the presumptions of many behavioristically influenced and consummatory-drive oriented theorists, environmental novelty is often craved because of our desire for extropy. But as Freud and Rank were ahead of their time in noticing, this craving for novelty, adventure, unpredictability, and higher-energy forms of experiencing often conflicts with our desire for homeostatic energy-efficiency, satiation, predictability, and Freud's "inertia," toward which our consummatory drives toward dull comfort would impel us if not counterbalanced.

Novelty, Constraints to Freedom, and the Action-Consciousness Connection

Any newly presented stimulus consists of a *change,* yet since the organism desires to maintain *continuity* in its successful patterns of homeostasis, it seems reasonable to assume that the basic physiological emotional tendencies are always addressed essentially to the issue of *novelty* in one way or another. Since any change could pose a threat to homeostasis, fear and anger are directed negatively at sudden new stimuli. But feelings toward novelty can be positive as well as negative. Panksepp's fundamental "seeking" tendency positively craves novelty. These emotional interests work in conflicting ways. Since our chemical self-organizing systems are motivated toward preserving homeostasis but without lapsing too much into inertia, it follows that we want to seek out novelty as a way to increase extropy, i.e. to get into higher-energy basins of attraction, which are the more conscious ones (see Ellis, 1986); but at the same time, novelty can be a threat to the integrity of the system, especially *vis a vis* maintaining homeostasis. Here again, extropy and homeostasis, though not always in conflict, are different motivational tendencies, because homeostasis can be achieved at either a higher- or a lower-energy basin of attraction.

The point at which homeostatic and extropic chemical issues for the organism as a whole are translated into neural (electrochemical) ones — i.e., the brain-stem/midbrain/limbic system — is where sell-organization, if sufficiently complex, meets consciousness, which requires efferent commands directed toward action affordances. According to Jeannerod (1994), action commands when inhibited give rise to action imagery. Since understanding an object in consciousness requires at least implicitly understanding its action affordances (Newton, 1996), this kind of action imagery is implicitly present in all consciousness, and ultimately must be emotionally motivated by the organism's general desire for homeostasis at a suitably extropic energy level.

Besides extropy and homeostasis, there is a third fundamental concern for any motivated being. Any self-organizing entity, if it is to remain an entity, must protect the *boundaries* within which it is free to act in its preferred patterns. Fear and anger responses are not simply blindly and automatically caused by the presentation of a stimulus; they are caused by the organism's attempts to continue its desired activity patterns into the future, as modified by perturbations in the environmental conditions needed to do so. The classic paradigm of anger, as measured by all its various physiological indices, is produced when the arms and legs of an infant are bound (Panksepp, 1998). The purpose of the organism in this case is not to inflict injury or destruction, but simply to break free. The movements toward which the organism is energized consist of pushing, lashing out, or flailing around. The same behaviors are observed any time the infant's free, self-directed movement is opposed or impeded. It is interesting to note that this same response gives infants the ability to swim (Dalton, 2000); the inability to breathe, perhaps the most confining of all feelings, triggers the flailing behavior. As a young animal develops, this general lashing out may lead to destruction or warding off of a predator. Later, the movements involved in breaking free may take on symbolic functions, so that an adult may express anger by behaving *as if* in the position of a confined infant.

It is especially important to realize that the predatory behavior of animals does not develop as a modification of this infantile anger response, but rather from two separate instinctual systems, the "seeking" and the "play" systems (Panksepp, 1998). An animal hunting is not distracted by angry symptoms, but is focused, controlled, gracefully poised, and in a state of appetitive enjoyment reminiscent of its play with other young animals of its own species. When play or hunting leads the animal into situations that *threaten* or *confine* it, on the other hand, *then* anger may be evoked as a secondary appendage to the initial playful and seeking motives. In many instances, the prey is unthreatening enough that no such anger responses need be evoked. At the beginning of the hunting behavior, at least, the animal's motives are similar to those in play with other young animals of its own species - strengthened of course by hunger but not requiring hunger *per se* — until the final kill, which behaviorally already resembles an eating or consuming behavior.

Given these boundary-protection needs, sudden environmental change not only can be positive, negative, or neutral depending on contextualization, but it can also be both intrinsically rewarding and threatening, because the organism has potentially conflicting aims - maintaining complexity at relatively high levels of energy, which systematically are preferred over lower levels of energy, but at the same time maintaining homeostasis and protecting the *boundaries* of its inner- directed activity against injury or confinement — conditions that interfere with the organism's ongoing activity toward homeostasis at a stuitable level of extropy.

Chronic “thrill seekers” are especially aware of these conflicting emotional responses to shocking, sudden changes.

Moreover, each of the conflicting tendencies can be either facilitated or opposed by environmental conditions, which can threaten the boundaries of activities in the service of both homeostasis and extropy, or can offer useful affordances for them. Extropy can be facilitated by interesting environmental conditions free of constraint, or it can be opposed by conditions that do constrain the desired pattern of activity. And the need for homeostasis can be opposed by environmental insult to the integrity of the organism, especially by violating its boundaries to cause injury or illness; or this same need can be facilitated by the environment when it offers sustenance and conditions conducive to rest.

The interactions of these organismic and environmental variables mean that any sufficiently complex organism (one that is a highly complex dynamical system) will necessarily exhibit at least three fundamental motivational needs, based on three inescapable overall purposes of the system: (1) extropy, (2) protection of the boundaries for its activities, and (3) homeostasis.

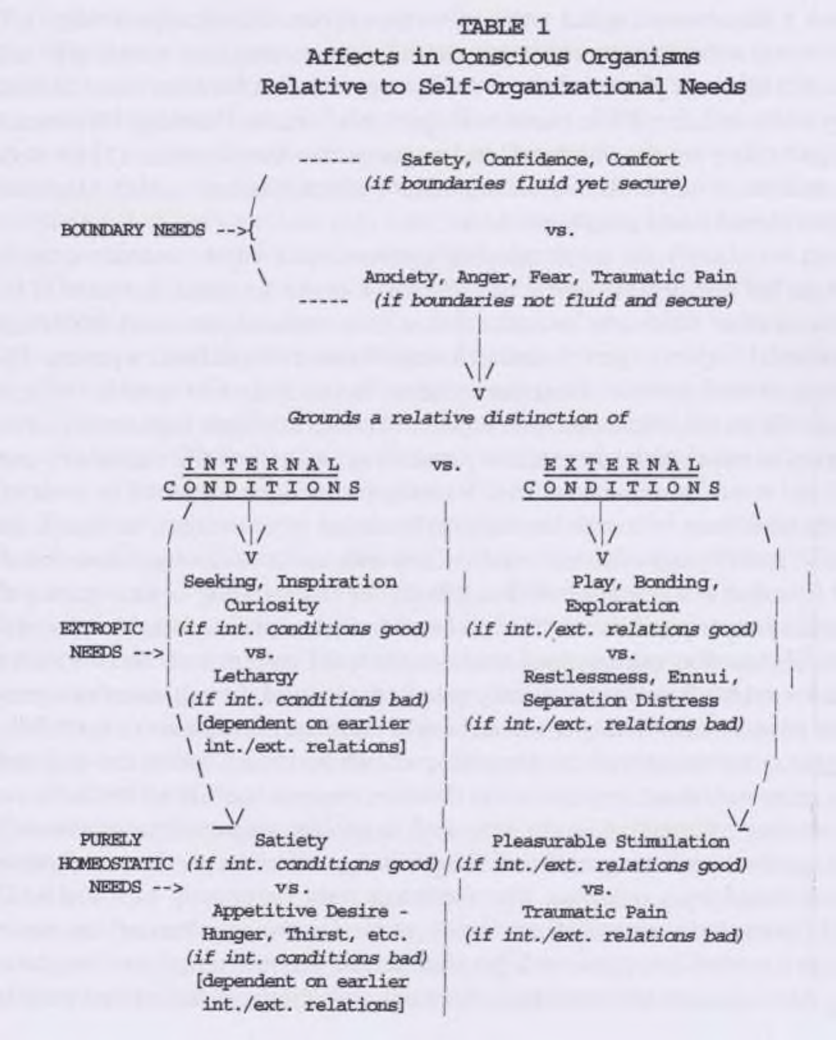
Thus there is a natural tendency of the organism: (1) to *seek* novelty, as a way of affirming the intrinsic value of its activity itself (not just instrumental value toward accomplishing *other* aims, such as tension reduction); (2) to *avoid* having freedom constricted/imprisoned (which involves our agency and makes us angry if too constrained — the object is to *break out* of the constriction). Constriction prevents us from freely acting to seek expression of *active* tendencies. Thus anger is a boundary-protection issue. Protecting the boundaries of the organism leads also to *fear* or suspicion of novelty. Physiologically as well as phenomenologically, there are very close interrelations between fear and anger (Panksepp, 1998). (3) Desire for consummatory pleasure/comfort, as we have seen, is also equilibrium-driven and homeostatic (by contrast to playful enjoyment of our activity *per se,* which is extropic).

Each of these tendencies can futher be divided according to (a) internal and (b) external conditions that affect their expression, and these effects can be either positive or negative, depending on whether the affordances presented by the relevant conditions (internal or external) are facilitative or thwarting. Based on this division, we can construct a list of twelve categories of affects that reflect motivations that will influence the behavior of any highly complex dynamical organism.

The chart begins by noticing that the distinction between internal and external conditions does not yet exist until there are boundary issues; the boundary gives rise to the internal and the external, each of which then can play either a facilitative or a thwarting role in relation to each of the other types of needs. Now it would be artificial to say that „extropy needs” could exist in isolation from boundary and homeostatic ones or that the latter could exist independently of each other.

But there is still an important sense in which extropy needs cannot even arise in the first place until a boundary is established to define the organism relative to its environment. This is not merely a physical boundary, but rather the definition of a unified self-organizing system in fluid interaction with its environment as it appropriates needed micro-constituents and other affordances of the environment. So the chart recognizes this point by allowing the boundary needs to have a special status, prior to the internal-external distinction which plays its role relative to the other needs.

Table 1. Affects in Conscious Organisms. Relative to Self-Organizational Needs



```
                              TABLE 1
                   Affects in Conscious Organisms
                Relative to Self-Organizational Needs

                     ------     Safety, Confidence, Comfort
                   /          (if boundaries fluid yet secure)
                  /
BOUNDARY NEEDS -->{                         vs.
                  \
                   \          Anxiety, Anger, Fear, Traumatic Pain
                     -----     (if boundaries not fluid and secure)
                                       |
                                       |
                                      \|/
                                       V
                     Grounds a relative distinction of

                I N T E R N A L         vs.       E X T E R N A L
               C O N D I T I O N S               C O N D I T I O N S
                 /      |              |                |              \
                /      \|/             |               \|/              \
               |        V              |                V                |
               | Seeking, Inspiration   |         Play, Bonding,          |
               |     Curiosity         |          Exploration            |
EXTROPIC       |(if int. conditions good)| (if int./ext. relations good) |
 NEEDS -->     |        vs.            |                vs.              |
               |     Lethargy          |        Restlessness, Ennui,      |
               \ (if int. conditions bad)|       Separation Distress     |
                \ [dependent on earlier |     (if int./ext. relations bad) |
                 \ int./ext. relations]  |                                |
                  \                     |                               /
                   \                    |                              /
                   _\/                  |                             \/
 PURELY               Satiety           |    Pleasurable Stimulation
HOMEOSTATIC  (if int. conditions good)| (if int./ext. relations good)
 NEEDS -->              vs.             |               vs.
              Appetitive Desire -        |          Traumatic Pain
              Hunger, Thirst, etc.       |    (if int./ext. relations bad)
             (if int. conditions bad)   |
              [dependent on earlier     |
               int./ext. relations]     |
```

As soon as boundaries have been established, and thus a somewhat fluid and interactive distinction between internal and external, the table then indicates that when internal conditions are facilitative of meeting extropy needs (when internal conditions are “good”), the resulting motivational tendencies are seeking, curiosity, or feelings of inspiration. When internal conditions are thwarting toward extropy needs (or “bad”), the result is lethargy. When *external* conditions are facilitative with respect to extropy, the results are bonding, play, lust, nurturance, etc. And so forth for the other needs, conditions, and motivational tendencies. Of course, we must always remember that internal conditions always already have been affected by earlier external ones, and avoid the temptation toward an over-simplified internal/external antithesis.

From a phenomenological point of view, anyone can introspect what it is like to be on a continuum (1) somewhere between inspiration/curiosity and lethargy; (2) between playfulness and restlessness, and/or between some form of empathy and loneliness; (3) between courage/confidence and anxiety; (4) between a feeling of safety on the one hand, and anger or fear on the other; (5) between wellness/satiation and sickness/consummatory dissatisfaction; and (6) between peripheral pleasure and peripheral pain.

When we classify the most universal emotions of complex animals in terms of an explicitly self-organizational perspective, it is the aims and activities of the organism, rather than any presumed constant association with particular environmental objects, that delineates each kind of emotional system. The hardwiring of endogenous emotional systems is not linked to specific objects, except insofar as specific objects are especially prone to trigger organismic action affordances in terms of the aims already underway because of the organism’s own patterns and structures of action. Fear, for example, may be triggered by a variety of objects, and there is no need to learn to be afraid of one object because it has been associated through classical conditioning with some other object that already elicited fear, due to association with a still earlier fear-evoking object, tracing all the way back to original unconditioned fearful objects such as heights or snakes — or to objects that once caused an unconditioned response to sheer physical pain. Any kind of object that suddenly gets in the way of the organism’s ongoing projected aims by constricting or threatening to constrict the organism’s boundaries can trigger either anger or fear, depending on what kind of action the organism initially imagines taking to remove the threat or remove itself from the threat.

From this perspective, even fear and anger are expressions of the selforganizing activity of an agent-directed organism, rather than passive, mechanical reactions caused by a stimulus. The organism must be already in a motivated and self-directed movement of activity in order for this freedom of movement then to be thwarted or constricted. In other words, all other emotional needs are actually dependent on the workings of the extropic systems: the animal must be energized in terms of general arousal before it can be motivated by any other need. And the basic extropic tendency is tied in with all the extropic tendencies of the brain, so that what gets energized is general curiosity and exploratory and playful behavior.

Novelty is therefore both good and bad for the organism. “Bad” novelty is, initially, any novelty that interferes with the ongoing self-organizing activity — i.e., that does not present good affordances for it. Then, very quickly, the novel stimulus either becomes confining, in such a way that it affords “pushing against” or breaking out of the confinement (hence anger and frustration); or it remains “uncanny,” just as if it were still completely novel and unexpected, as if we were seeing it afresh, and we remain immobilized (hence fear, terror, or anxiety). Phylogenetically, this tendency originally came about because, in a dangerous situation where any move could kill the organism, it is best for it not to move, until it figures out what is going on. Thus both fear and anger are preceded by a more fundamental “startle” response (Panksepp, 2000). Some situations stick us in that “uncanny” mode, because we continue to be unable to determine what action to take. So then our own immobility *is* what feels confining. The confinement of our own fear may later lead to an anger which then breaks us out of the confinement and leads to energized action.

Thus the difference between fear and anger is that anger means feeling confined by something external and wanting to break free, whereas fear is feeling confined by our own immobility in contending with a threatening novelty. The difference is in whether the confinement is self-initiated or object-initiated, although both may be responses to a similar object. In general, bad novelty feels confining, in one way or another. Whether in fear or in anger, confinement constricts a self-organizing freedom of movement, which is a precondition for either response.

But it is important not to oversimplify here. We all too often assume that those emotions that are most universally experienced are the “basic” ones, and that all the others are “derivative” from them. But this is not a logical inference. The properties shared by all members of a certain class are not the ones from which we can derive other properties those members may possess. All softballs have stitches and are spherical, but it does not follow that all other properties of softballs are derivative from these. There are many and various different emotions that feel confining when our freedom to realize complex action potentials are not afforded by the environment, and these include grief and separation distress. In these cases, the experienced *lack* (Lacan’s “missing object”) constricts us. For example, many people in the grips of grief feel almost as if they cannot breathe. Thus it is not counterintuitive that Panksepp classifies separation distress as a separate “panic” system in the brain. When an important relationship facilitates a subject’s being in a more interesting, higher-energy basin of attraction, the withdrawal of that love object means constriction of freedom.

But a further dimension of separation distress is that it leads to *despair*. This despair relates to the fact that love enables the subject to value being *per se* more intensely. Loss of a love object withdraws this “being-valuing” action affordance (“being-valuing,” because the act of valuing being entails action affordances, and is itself a complex pattern of brain processes that requires extropic activity); the subject can no longer as intensely value its own activity, and seeks a less active, lower-energy basin of attraction, lapsing into entropy and depression. Yet the desire to live, still pronounced in other subsystems, feels constricted by this very entropy, so that those subsystems force the experience of restless anxiety and a feeling of painful tension and confinement.

Even though bad novelty can trigger fear, anger, or separation distress, it is equally true that good novelty can feel liberating — it presents affordances consistent with the body’s ongoing desire to keep flowing in natural patterns, but to increase the energy level while doing so. Thus anger and fear, just as much as joy or play, *intend* the organism’s self-initiated activity toward maintaining a self-organizing pattern, and are not just causal reactions to external stimuli. This is an important point for integrating physiology with existential emotional issues, because it allows anger and fear to be conceived in terms of the organism’s already ongoing activity, rather than as causal reactions to an external stimulus. In this way, we can make phenomenological sense of what it is that the organism *wants*, as correlated with its basic self-organizational structure, rather than simply regarding anger and fear as either arbitrary causal reactions, or as tendencies derived through learning from consummatory drives. The intentional aim of every emotion is to continue the pattern of self-directed activity whose purpose is to maintain the organism’s overall active pattern of being.

The Importance of Extropy Needs in Higher Mammals

The higher we go on the evolutionary scale (and also the more consciousness there is), the more the organism wants to deviate from equilibrium and find more extropic basins of attraction which can also facilitate homeostasis. Each organism has many basins it can settle into, and it was advantageous for a hunting/ gathering creature to develop a tendency to prefer the higher energy (seeking) ones. This is the genetic hand we are dealt with regard to physiological emotional tendencies. We have a natural tendency to prefer extropy, but that tendency often can conflict with the preference for homeostasis, and the basic physiological emotional tendencies are complex ways of addressing these internally-conflicting concerns. Of course, an inherent desire to explore, a sense of general curiosity, and a need for intellectual stimulation, even when such activities do not lead to consummatory reward, are going to be selectively favored for survival in a hunting and gathering gene pool. An important existential parameter addressed by this concept is also the need not just to *achieve* whatever it is we value, but also to *affirm the value* of what we value — to feel that it *is* valuable. If we did not feel inspired to exercise our capacity for the realization of our activity at more extropic basins of attraction, we would lapse into lower energy ones. Thus the feeling of *inspiration* - the Aristotelian valuing of our own activity for its own sake, for the sheer interest of it - correlates with the release of DA and NE, which are neurotransmitters that facilitate efferent action commands and make us feel more conscious, more "alive," and, quite literally, more awake. Hence the power of caffeine addiction, which directly stimulates the release of NE, and indirectly of DA. In order to exist at our most extropic basins of attraction, we must feel that doing so is worthwhile, i.e., we must feel "inspired."

Lists of "basic emotions" that do not include the need for something like a feeling of inspiration are therefore too impoverished to be applicable to the motivational structure of highly complex self-organizing animals. Even a dog or cat can feel inspired or, on the contrary, generally lethargic and uninterested in its environment. In an extreme case, we know that marasmus infants can die even though all their consummatory needs are met (Spitz & Wolf, 1946).

There are entire categories of human activity whose purpose is not to attain that which we value, but to intensify our sense that it *is* valuable through a feeling of inspiration. Religion, love, and the arts are examples of such "value-affirming" as opposed to "value achieving" activities. Love, for example, is an indispensable existential need as well as a basic physiological tendency of the brain. Love presents another being who is novel as opposed to boring (in terms of moment to moment lack of predictability) and liberating as opposed to confining, yet not threatening the way some novel stimuli are. We vicariously experience the other as someone whose being-structure would be interesting to enact, and we try to do so as nearly as possible through empathy. Correlatively, in love we experience the other as extremely *valuable,* so that an existential sense that the overall struggle is worthwhile can be served. The behaviors of love are often meant to enhance the experience of this inspiration rather than to achieve the outcomes posited as valuable by the value feelings that are intensified in the process (for a more elaborate discussion of this example, see Ellis 1986).

Existential Requirements for an Adequate Dynamical Theory of Emotion

We have seen that there are three aim-oriented issues involved in being a complex self-organizing being, all stemming from the fact that our basic tendency, in order to be what we are, is to act out our own unique pattern of being in ways that maintain both extropy and homeostasis. (1) We need extropy. This means that we need to have novelty, because novelty affords extropic activity. It also implies that we need to find ways to further concretely embody our conscious states so as to amplify them, which entails symbolization. I.e., we feel conscious states more intensely when we express them concretely. For example, uttering eulogies intensifies grief, caressing a loved one or singing love songs intensifies the feeling of love, and clenching the fists intensifies anger. Similarly, we grasp our general felt sense of a situation more vividly when we try to put it into words. This need for symbolization in turn leads to speech, art forms, and relations to others, so that we can have media through which to symbolize and thus amplify the activities of our being (see Ellis, 1999b). (2) We need to protect the *boundaries* of our being, since to be is to be within certain boundaries. This means that we become *startled* and thus *freeze* at the *unfamiliar* or *uncanny;* we then need to further process the unfamiliar so that it ceases to be uncanny, which entails *symbolization* and *imagery of action affordances* in relation to the threatening object. This also often includes expressing our symbolizations to others, in the interest of further clarification and amplification of our consciousness of what is going on; and of course we finally need to either get away from or destroy the uncanny thing that threatens our *freedom of action,* which requires a self-energizing to break out of the *confinement* either of our own immobilizing *fear*, or of the dominance of the predator *(anger).* (3) We need to reduce our chemical imbalances, so as to achieve *homeostasis.* This implies that we need *predictability/familiarity* in the environment. This also entails a need for further clarification of what it is that we need and want, which again leads to *imagery/ /symbolization,* and to *cooperative* arrangements with others to meet the needs, since cooperation is the main way mammals are adapted to meet them. This leads still further to feelings of being motivated to form social bonds.

Correlatively with (1), we need to experience the project of achieving all these goals as one that has *value per se,* rather than as meaningless and pointless. I.e., we need to feel that being what we are (or being anything) is worthwhile or has value — that the entire project of being is worth the effort. This implies the need for an object that affords *play* (extropic homeostasis) — and the only completely adequate object for this purpose is *another conscious being.* We then need *imagistic symbolization* to amplify our experience *of* the value of the play-affording object, i.e., the other person (which can mean expressing our feeling of the value *to* others, or just to ourselves); and we need to act in relation to the valued object, in such a way as to amplify our experience of its value — which leads to *friendship, respect, loyalty,* and many other social emotions.

Phenomenological experiencing of emotion can be correlated, given a detailed enough account, with what complex self-organizing (homeostasis-within-extropy-craving) beings need, in chemical terms. The need for extropy correlates with what Panksepp (1988) calls the brain's SEEKING system (curiosity, boredom, vigilance, enthusiasm for activity), and also the WAKEFULNESS AND AROUSAL system. (I follow Panksepp's convention of using all caps for his proposed emotional brain systems.) These tendencies cause the total self-organizing system to try to use norepinephrine (NE), dopamine (DA) and other such chemicals to amplify the activity level of the system. Hence the need for social relations, because other conscious beings afford novelty and unpredictability within safety.

The need for homeostasis correlates with the consummatory PLEASURE-PAIN system, which *when combined with the other needs* leads to social integration of pleasure-pain issues through the brain's PLAY, LUST and NURTURANCE systems (and in less direct ways to other social emotions).

The need for secure boundaries and freedom of activity within those boundaries correlates with the *startle* response to "bad" novelty, which leads to enaction of either the FEAR or ANGER systems as ways to *self-energize* and reassert *freedom of action* (unconfined by the bad novel stimulus, whose effect is to confine and prevent free activity).

The need to experience the project of being as worth the effort (the need for inspiration) is a further elaboration of the arousal and seeking systems, and correlates with Panksepp's SEPARATION DISTRESS (or what Panksepp also calls the *"panic")* system, which is the negative manifestation of a LOVE system, also including LUST and NURTURANCE (utilizing release of oxytocin in the brain), as well as friendship and PLAY (combining oxytocin with energizing DA, NE, and other neurotransmitters). Ultimately, we need others in relation to whom we can fully express what we are — which is just as fundamental and existential a need as eating or protecting one's boundaries. The failure to achieve this aim is *depression,* which correlates with chemical imbalances of the total system, but ultimately stems from a failure to *energize* the system at a high enough level of extropy, since the value of doing so needs to be felt in order to motivate doing so. Thus dogs act listless and disoriented when they fail to get the kind of play, social interaction, and even obedience training that they want (being such an extremely cooperative species). Death through marasmus in human infants is the clearest instance of total failure of this system.

Although we speak of self-organizing systems as having a "tendency" to appropriate whatever physical elements are needed to keep the system going in its preferred patterns, and readjusting to a different basin of attraction to compensate for changes in the environment, we should of course remember that maintaining a complex self-organizing system is not at all *easy,* and requires the cooperation of several different extraneous mechanisms, such as the gifts we inherit through long and hard natural selection, and conscious planning, and good luck in terms of environmental conditions — and even then, of course, the project is ultimately doomed to eventual failure. Even a tiny disruption of the evolutionary legacy, such as a stroke, can make the project impossible — and probably in almost all instances the best we can do is to come close to achieving all the elements for the total extropic-homeostatic balance that is desired.

The complexities resulting from anticipation of this ultimate failure in death affects the most intelligent organisms in such an important way that the need to appreciate the value of being *per se,* as instantiated in beloved others and experienced through positive relations with others, becomes still further pronounced than it would be in an animal unintelligent enough to simply live in the present moment without concern about death and other conditions of finitude.

Toward an Integrated Physiological and Phenomenological Account

The tendency of the most complex self-organizing systems toward extropy is a good candidate for explaining the “SEEKING” and “PLAY” systems — so important in the conflict between consummatory drive reductionism and the “higher” or “existential” emotions — from a self-organizing perspective. Novelty is a preperceptual category that is always recognized by the emotional limbic system prior to perceptual processing (LeDoux, 1996; Damasio, 1999). The first instantaneous response to real novelty — novelty of a kind for which we are completely unprepared by any kind of past experience — is a startle reflex, which has basic emotional-brain ramifications. Then, as the novel stimulus has time to be processed further, if it continues to be novel in a bad way (in a way that does not present self-actualizing affordances), the startle response quickly evolves into a mild fear response, i.e., freezing. Natural selection serves well enough as an explanation for this form of organization: We are better off doing nothing when any wrong move could mean death. Subsequently, the freezing becomes a confinement, and confinement is the essential issue that provokes either flight, or a kind of energized rage response, either of which breaks us out of the frozen startle response and equips us for action. On the other hand, if the novel stimulus presents good novelty (self-actualizing action affordances), then the seeking and play systems go into action.

We can thus account in existential terms for Panksepp’s SEEKING, PLAY, RAGE, and FEAR systems. With regard to his LUST/NURTURANCE and SEPARATION DISTRESS systems: All three of these brain systems activate social emotions involving empathy (and thus utilization of oxytocin circuits in the brain). These systems too can be given existential accounts. In order to actualize ourselves, we need to be in interaction with others — that is the nature of mammals (and of intensely conscious beings as conceived of in existential terms). When not in interaction with others, either directly or indirectly, it may become impossible for us to *be* what we are; our self-organizing systems cannot maintain themselves, and we feel the resulting failure of both homeostasis *and* extropy. “Lust” and “nurturance” are similar to each other both physiologically (Panksepp, 1998) and phenomenologically (Ellis, 1996b); they involve actualizing one’s being through empathy with another, and experiencing the value of being as instantiated in the other through empathy. Sex too (which is not really necessary for reproduction in lower species) evolved hand in hand with these tendencies toward empathy.

This does not explain, of course, why sex gives *pleasure* — that explanation would be more elementary, having to do with achieving chemical homeostasis. What the need for higher value experience explains is why we are the kind of beings that associate sexual reproduction with empathy in the first place — why we connect the sexual pleasure with the perception of other beings of the opposite sex (in a way that empathizes with them) rather than, say, thinking about algebraic equations or of nothing at all while ejaculating. (The evolutionary reason, of course, is that beings that thought about algebraic equations while ejaculating didn’t reproduce themselves as well, and thus didn’t compete well with those who thought empathically about other beings while doing it). Without this empathic dimension, we have acute distress, because we either cannot *be* what we are, or we cannot see the full *value* of being what we are (or of being anything at all) — which is a frequent precurser to depression (Panksepp, 1998).

Understanding *why* we need others to actualize our being requires understanding the structure of the self or personality, which is a higher-order pattern of progressing from one conscious state to another: A personality can be identified by the pattern in the directions of those changes, which is a style of being, rather than by a mere listing of *which* conscious states are experienced; we might all experience them all, at various times (Ellis, 1986, 1998b). So to be what we are, we have to relate to others who will allow the right kind of pattern of progression from one state to the next, in addition to allowing progressions that generally afford extropy within homeostasis. For each individual, different patterns will be required to achieve these ends, since the ends themselves have to do with complex structures of dynamic change.

In conclusion, we have seen that contemporary neurophysiology of the emotions does not require a simplistic egoistic-hedonist and consummatory-drive- reductivist view of the emotional life, but is generally consistent with the demands of existentialists and self-actualization psychologists. The key to reconciling physiology with these higher-order ways of seeing the meaning of emotions is to approach the physiology underlying consciousness itself in terms of complex self-organizing systems that seek extropic basins of attraction as well as homeostasis.

References

Alexander, David, & Globus, Gordon (1996). Edge-of chaos dynamics in recursively organized neural systems. In Earl MacCormac and Maxim Stamenov (Eds.), *Fractals of Brain, Fractals of Mind.* Amsterdam: John Benjamins.

Anderson, Carl, & Mandell, Arnold (1996). Fractal time and the foundations of consciousness: Vertical convergence of 1/f phenomena from ion channels to behavioral states. In Earl MacCormac and Maxim Stamenov (Eds.), *Fractals of Brain, Fractals of Mind.* Amsterdam: John Benjamins.

Aureli, Carl G. (1989). Man's triune conscious mind. *Perceptual and Motor Skills* 58: 180-182.

Baker, Jeffrey, & Allen, Garland (1968). *A Course in Biology.* London: Addison-Wesley.

Bertalanffy, Ludwig von (1933/1962). *Modern Theories of Development: An Introduction to Theoretical Biology* (New York: Harper).

Bickle, John (1992). Multiple realizability and pschophysical reduction. *Behavior and Philosophy* 20: 75-88.

Campbell, Neil (1987). *Biology.* Menlo Park, CA: Benjamin/Cummings.

Chalmers, David (1995), Facing up to the problem of consciousness, *Journal of Consciousness Studies,* 2: 200-219.

Coles, M., Gratton, G. & Fabiani, M. (1990). Event-related brain potentials. In *Principles of Psychophysiology.* Cambridge: Cambridge University Press, pp. 413-453.

Dalton, Thomas (2000) The developmental roots of consciousness and emotional experience. *Consciousness & Emotion* 1: 57-92.

Damasio, Antonio (1999), *The Feeling of What Happens.* New York: Harcourt Brace.

Dashiell, J.F. (1925) A quantitative demonstration of animal drive. *Journal of Comparative Psychology* 5: 205-8.

Ellis, Ralph D. (1986) *An Ontology of Consciousness.* Dordrecht: Kluwer/Martinus Nijhoff.

Ell is, Ralph D. (1995) *Questioning Consciousness: The Interplay of Imagery, Cognition and Emotion in the Human Brain.* Amsterdam: John Benjamins.

Ellis, Ralph D. (1996a) Ray Jackendoff's phenomenology of language as a refutation of the appendage theory of consciousness. *Pragmatics & Cognition* 4: 125-37.

Ellis, Ralph D. (1996b), *Eros in a Narcissistic Culture.* Dordrecht: Kluwer.

Ellis, Ralph D. (1999a). Dynamical systems as an approach to consciousness: Emotion, self-organization, and the mind-body problem. *New Ideas in Psychology,* 17: 237- -250.

Ellis, Ralph D. (1999b). Why isn't consciousness empirically observable? Emotion, self-organization, and nonreductive physicalism. *Journal of Mind and Behavior,* 20: 391- -402.

Ellis, Ralph D. (2000a). Consciousness, self-organization, and the process-substratum relation: Rethinking nonreductive physicalism. *Philosophical Psychology,* 13: 173- -190.

Ellis, Ralph D. (2000b). Efferent brain processes and the enactive approach to consciousness. *Journal of Consciousness Studies,* 7: 40-50.

Ellis, Ralph D. (2000c) Three elements of causation: Biconditionality, asymmetry, and experimental manipulability. *Pliilosoplua,* 29: 1-21.

Ellis, Ralph D. (2000d) Integrating the physiological and phenomenological dimensions of affect and motivation. In R. Ellis and N. Newton (Eds.), *The Caldron of Consciousness: Motivation, Affect, and Self-organization.* Amsterdam: John Benjamins, pp. 91-108.

Ellis, Ralph D. & Newton, Natika (1998a). *Consciousness and the Brain: An Annotated Bibliography,* http://earthlink.net/~dravita.

Ellis, Ralph D. & Newton, Natika (1998b). Three paradoxes of phenomenal consciousness: Bridging the explanatory gap. *Journal of Consciousness Studies, 5:* 419-442.

Ellis, Ralph D., & Newton, Natika (Eds.) (2000a). *The Caldron of Conscioiusness: Affect, Motivation, and Self-organization.* Amsterdam: John Benjamins.

Ellis, Ralph D., & Newton, Natika (2000b). The interdependence of consciousness and emotion. *Consciousness & Emotion,* 1: 1-11.

Faw, Bill (2000) Consciousness, motivation, and emotion: Biopsychological reflections. In Ellis and Newton, *The Caldron of Consciousness.* Amsterdam: John Benjamins, pp. 55-90.

Freeman, Walter (1987). Simulation of Chaotic EEG Patterns with a Dynamic Model of the Olfactory System. *Biological Cybernetics,* 56: 139-150.

Freud, Sigmund (1959), *Beyond the Pleasure Principle.* New York: Bantam.

Goleman, Daniel (1994), *Emotional Intelligence.* New York, Bantam.

Harlow, H.F. (1950) Learning motivated by a manipulation drive. *Journal of Experimental Psychology,* 40: 228-34.

Hull, C. L. (1952) *A Behavior System.* New Haven: Yale University Press.

Husserl, Edmund (1913) *Logical Investigations.* New York: Humanities Press.

Hutto, Daniel (2000) *Beyond Physicalism.* Amsterdam/Philadelphia: John Benjamins. Jackendoff, Ray (1996). How language helps us think. *Pragmatics & Cognition,* 4: 1-34. Jackson, Frank (1986). What Mary didn't know, *Journal of Philosophy,* 83: 291-295. Jeannerod, M. 1994. The Representing Brain: Neural Correlates of Motor Intention and Imagery. *Behavioral and Brain Sciences* 17 (2): 187-244.

Kagan, J., & Berkun, M. (1954) The reward value of running activity. *Journal of Comparative Physiological Psychology* 47: 108-10.

Kauffman, Stuart (1993), *The Origins of Order.* Oxford: Oxford University Press.

Kim, Jaegwon (1992). Multiple realization and the metaphysics of reduction. *Philosophy and Phenomenological Research,* 52: 1-26.

LeDoux, Jean (1996), *The Emotional Brain.* New York: Simon and Schuster. MacCormack, Earl & Stamenov, Maxim, eds (1996), *Fractals of Brain, Fractals of Mind.* Amsterdam: John Benjamins.

Mack, Arien, & Rock, Irvin (1998), *Inattentional Blindness.* Cambridge: MIT/Bradford. Maslow, Abraham, *Motivation and Personality.* NY: Harper & Row, 1954.

May, Rollo, *Love and Will.* New York: W.W. Norton, 1969.

Merleau-Ponty, Maurice (1942), *The Structure of Behavior.* Boston: Beacon, 1963.

Monod, Jacques (1971), *Chance and Necessity.* New York: Random House. Montgomery, K.G. (1955) The role of the exploratory drive in learning. *Journal of Comparative Physiological Psychology* 47: 60-64.

Newton, Natika (1996), *Foundations of understanding.* Amsterdam: John Benjamins. Newton, Natika (2000) Conscious emotion in a dynamic system: How I can know how I feel. In R. Ellis and N. Newton (Eds.), *The Caldron of Consciousness: Motivation, Affect, and Self-organization.* Amsterdam: John Benjamins, pp. 91-108.

Nissen, H.W. (1930) A study of exploratory behavior in the white rat. *Journal of Genetic Psychology* 37: 361-76

Ornstein, Robert, & Thompson, Richard (1984) *The Amazing Brain.* Boston: Houghton Mifflin.

Panksepp, Jaak (1998), *Affective Neuroscience.* New York: Oxford.

Panksepp, Jaak (2000) The neuro-evolutionary cusp between emotions and cognitions: Implications for understanding consciousness and the emergence of a unified mind science. *Consciousness & Emotion* 1: 17-56.

Pavlov, I.P. (1929) *Lecons sur I'activite du cortex cerebral.* Paris: Legrand.

Rank, Otto (1924), *The Trauma of Birth.* New York: Dover, 1993.

Schmahmann, Jeremy (Ed.) (1997). *The Cerebellum and Cognition.* New York: Academic Press.

Spence, K. W. (1956) *Behavior Theory and Conditioning.* New Haven: Yale University Press.

Spitz, R.A., & Wolf, K.M. (1946) Anaclitic depression: An inquiry into the genesis of psychiatric conditions in early childhood. *P.A. Study of the Child, II.* New York: International University Press, 1946,

Thelen, Esther, & Smith, Linda (1994), *A Dynamic Systems Approach to the Development of Cognition and Action.* Cambridge: MIT Bradford.

Varela, Francisco, Thompson, Evan, & Rosch, Eleanor (1993), *The Embodied Mind* Cambridge: The MIT Press, 1991.

Watt, Douglas. 1998. Affect and the “hard problem”: Neurodevelopmental and corticolimbic network issues. *Consciousness Research Abstracts: Toward a Science of Consciousness, Tucson 1998,* pp. 91-92.

White, Robert (1959) Motivation reconsidered. *Psychological Review* 65: 297-333. Wolfe, J.B., & Kapłon, M.D. (1941) Effect of amount of reward and consummative activity on learning in chickens. *Journal of Comparative Psychology* 31: 353-61.

Woodruff-Pak, Diana S. (1997) Clasical conditioning. In J. Schmahmann (Ed.), *The Cerebellum and Cognition.* New York: Academic Press, pp. 342-66.

Zachar, Peter (2000) Child development and the regulation of affect and cognition in consciousness: A view from object relations theory. In R. Ellis and N. Newton (Eds.), *The Caldron of Consciousness: Motivation, Affect, and Self-organization.* Amsterdam: John Benjamins, pp. 205-222.