CASE STUDY

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ON THE MICROGENOGESIS OF SCHIZOPHRENIA

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SUMMARY

Background: The theory of microgenesis, as described by Jason Brown and others, involves the hierarchical elaboration of the self and object world from a deep core of self, from unconsciousness to consciousnesss, through a simultaneous interval of time that continuously reiterates the development of the individual and the evolution of the organism.

Material/ Methods: The core features of microgenesis place demands on our view of time, which are addressed and fully formulated here in terms of dynamical systems theory, and generalized to all dynamical systems, including abiotic systems. We further formulate microgenesis in the more general physical theories of information and the foundations of dynamical states in physics. A dissociative model of the microgenesis of schizophrenia is proposed based on this formulation, and a case study is presented utilizing this model.

Results: The neurobiology of schizophrenia is indicative of abnormalities in functional connectivity and activation of the brain. Psychologically, there is also an apparent disintegration or fragmentation of self, which we describe in terms of the association and dissociation entropies of the self-construct, presenting a simple paradigm of the schizophrenic break as a dynamically enduring process that arises when the dissociation entropy exceeds the association entropy or the self construct. The case study presented demonstrates the successful reduction of the level of self-dissociation using hypnotherapy.

Conclusions: The dissociative construct of self is emphasized as a microgenetic model where dissociation is, fundamentally, a loss of cohesion and splitting of the self-construct. Multiple working hypotheses of schizophrenia, the self, and the broad scientific implications of microgenesis are outlined, and future directions of inquiry are addressed.

Key words: self-disorder, dynamical systems theory, dissociation entropy, association entropy

INTRODUCTION

The fundamental premise of this paper is that, according to the microgenetic theory of Jason Brown, schizophrenia can be described as a fragmentation or dissociation of the self as it actuates from the timeless core of self, imbued with subjectivity *ab initio*, into the temporally realized conscious self and objects in a real world. In the normal, sane individual, the microgenetic process moves through a simultaneous interval, which begins as the subjective core where the self/object duality has not yet evolved, and ends at the surface, at the end of this interval of duration, with a separate self, which has a unitary and integral relationship with the object-world. This end point can be looked at as the surface of a series of layers through which the history of the individual and evolution of the organism are stratified, not in a temporal, but in a genetic or causal sense. Figure 1 shows Brown's simplified diagrammatic representation of the process of microgenesis.

In the theory of microgenesis, this evolution from depth to surface can be conceived, in the life of the individual, as a continuous re-creation of mind, which not only includes those conscious end points that are perceived in the integral world of consciousness, but is a repetition of the entire microgenetic process. If we reduce each duration of the microgenetic state to a point, then, we can construct a line in the history of self, or world line, as it is reified in the real world, and this line would be singular in the sense that the same self and the same world are continually re-created in time from the non-temporal core of self.

The separation of self and object, as we know, was not for "primitive" humans the same as the strict separation that we now perceive as modern humans. Objects were imbued with a life of their own, which was seen as continuous with the life of the individual and the community of individuals, who constituted a world that was experienced as fully interpersonal and yet intrapsychic and subjective, restricted at first to the life of the group, until, in

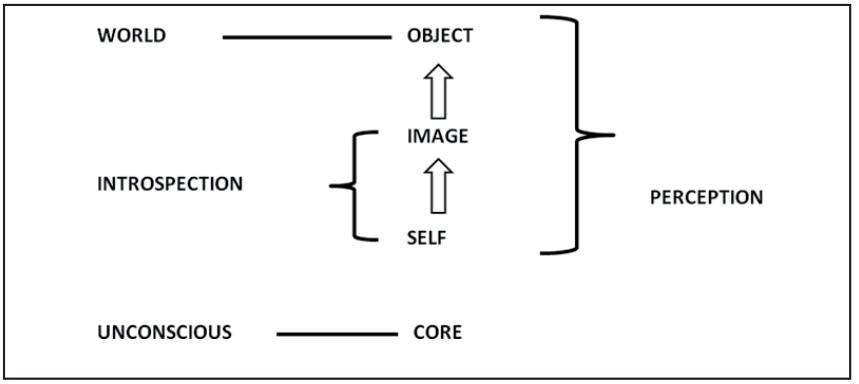

Fig. 1. Microgenetic process. The unconscious core of self gives rise to the self-complex, from which an internal self in an external object world arise in perception. Diagram courtesy of Jason Brown

the relatively recent evolutionary past, as the species developed from its restricted and perilous past some tens of thousands of years ago, to occupation of contiguous areas in space.

The subject/object distinction and the subject/predicate distinction are disturbed in schizophrenia [Arieti, 1974]. In view of the genesis of these distinctions in the relatively recent evolutionary past, they must lie close to the surface, at the individuation stage of the child. Schizophrenia is unknown prior to this time, and has its peak onset in late adolescence to early adulthood. If we consider schizophrenia to involve, essentially, a dissociation of self, a kind of bifurcation in the microgeny of self, then it might be expected to be associated with some trauma, which does not, in most cases, appear to be the case.

The peak onset of schizophrenia is at around the time of individuation from the relative dependency of adolescence to the individuation of adult, independent living. Perhaps this is a developmental trauma. The completely objectified object world is emotionally barren, and, to such an extent that this is the case, would represent a subjective apocalypse. Beyond this, an objectification of self would, in a sense, fundamentally represent self-extinction. Given our recent evolutionary history, such an objectification may be unnatural to some, and the threat of self-extinction is, in my experience, a battle that many schizophrenics spend a lifetime fighting.

Silvano Arieti [1974], who formulated a microgenetic theory of schizophrenia based on the earlier microgenetic theory of Heinz Werner, certainly seemed to think that the exigencies of modern industrial culture have a lot to do with the development and severity of schizophrenia, and presented some epidemiological evidence to support this assertion, as well as some more anecdotal evidence. Arieti [1974] stressed industrialization and urbanization as epidemiological factors involved in the development of schizophrenia. He concluded that paleological thinking, present in our not-so-distant ancestors, is the dominant mode of thought in schizophrenia.

In schizophrenia, according to Arieti, paleological thinking is a disorder in the basic functions of language and its underlying logic. Paleological thinking is prone to a fundamental disorder in logical inference and predicative inference, and leads to the extreme disorganization characterizing “word salad.” He characterized normal modern thinking as Aristotelian [Arieti, 1974]. The logic of Aristotle was based on deduction, and Arieti found this function profoundly impaired in schizophrenics, especially in the area of predication. Arieti [1974, 230-231] gave examples of such errors in predication in patients with schizophrenia, such as: “The Virgin Mary was a virgin; I am a virgin, therefore I am the Virgin Mary.” Arieti clearly distinguished the self from the self-image, or the self as in a mirror. Here we refer to the larger construct of self as the self-complex, which includes all of its derivatives within the realm of self-image, and the persona or ego as a complex related to a whole to part specification of self, which would be its logical specification in microgenesis. Arieti [1974] focused on the disturbance of a particular abnormality in schiz-

ophrenia of the function of the self-image in the category of self-identity, also called ego-identity, which is the unity and continuity of one's view of oneself over time.

The terminological confusion of self, self-image, ego, and persona is unfortunate, as they are commonly used, and often thought to be the same, which is not the view of microgenesis. The relationship between schizophrenia and self-disturbance seems to be implied by Jason Brown [2000, 110]: "The reality of the world is linked to the integrity of the self. A real self does not feel that an imaginary world is real, nor that a real world is imaginary." One might say that the "real self" is lost in schizophrenia. So, the loss of self, annihilation, in a sense, seems to be at the core of schizophrenia. As we will discuss later, however, the core of deep self, as Brown calls it, is the basis for all microgenetic process, such that its annihilation would be an annihilation of all mental process, which is clearly not the case. The "real self" would then have to be lost in the upward microgeny of self, at some level prior to the actualization of the real object world. It would be impossible to argue, however, that the schizophrenic does not have some self-construct, but fairly easy to argue that there is a dissociated, fragmented self-construct. This loss of a real self might happen at a much higher level of microgenesis, as seems to be implied by Brown [2000, 110]: "The feeling that is apportioned to the object, that normally deposits in the object as value and the sense of reality, is now attenuated in its outward trajectory. The retraction of feeling deprives the object of realness. It becomes lifeless, mechanical."

INITIAL PERSPECTIVES ON MICROGENY

The specifics of self in microgeny are important as we formulate a theory of schizophrenia based on dissociation of self in microgenetic process. As to the root of microgenesis, Brown [1996, 78-79] states: "The primitive will is the first actuality of mental process, the instinct to survive that is the unconscious urge to subjectivity. The inception is with a configuration in upper brainstem or diencephalon that deposits a core of incipient acts and precepts…The deep self is the precursor of concepts and objects and creates the inner life…The primitive will is the origin of drive and affect and creates a subject."

Brown (2000) elaborated in the process of the self giving rise to the objects of perception and the temporal world a series of whole-to-part specifications. The core of self essentially endures through the timeless duration of the becoming of the mental state (116): "The self at the core of the mental state remains alive with the actual surface to form a whole entity of mind and object. This is possible because becoming is nontemporal. A whole entity, a fully unfolded mental state, has to be achieved before there are temporal facts."

Brown (2000) elaborated on the neuropsychology of the process of self realization as being "deposited" with each instantiation of the mental state, and on the microgenetic "truncation" and subsequent "erosion of the self"

that, we will argue, is the fundamental basis of the self-disorder or dissociative self in schizophrenia (121): "…the neuropsychological material demonstrates that the self is deposited in the process of object realization, that it distributes into images and objects, and that a truncation of this process results in an erosion of the self that is similar across the different perceptual modalities. The self is categorical and relational, achieving autonomy in the context of a complete derivation. The autonomy depends on the completeness. The preliminary locus of the self in the mental state entails a holistic or multimodal phase of potential prior to perceptual individuation. This, together with a relation to feeling, to the personal history and the immediate past, point to a limbic transition in the outward development of the mental state." This limbic transition implies a transition to the higher levels of the cerebral cortex.

Dissociation, with respect to the mind, is a deficit in the action of association of an integral perception of a real self in a real world. It refers to various feeling and perceptions of an unreal or altered reality of self (depersonalization) and the object world (derealization). Jason Brown [2004] describes the dynamic of association in terms of proto-desires and proto-intensions, in the deeper microgenenic process of instincts and drives, and surfacing through the process of neoteny [Brown 1996, Brown & Pachalska, 2003; Pachalska 2002; Pachalska & MacQueen, 2002]. Neoteny is a reversion in evolution to an earlier stage of development. Thus, proto-drives and proto-intentions reflect a deeper process of drive and intention, in evolutionary terms. Brown describes the association process along these lines, with a particular emphasis on inwardness [2004, 117]:

> The progressive accentuation of subjective phases in drive and the increasing prominence given to the drive aspect of instinct signal a trend toward further inwardness, i.e. the heightened emphasis on preliminary ("pre-processing") phases. Inwardness retards action in the prominence of feeling, and retards object development in the prominence of images and ideas. Feeling is the dynamic in ideation. Ideas are the embodiments of feeling tones. What appears as an interaction or association of disparate mental objects is the outcome of drive-representations distributing into conceptual feelings in the evolution of proto-desire or proto-intention. The lack of immediate discharge in instinctual drive, and the retardation of contact with drive-objects, is a neotenous effect [Brown1996, Brown & Pachalska 2003] that permits greater diversity and individuation of cognitive targets, and the elaboration of a more complex interior life.

This passage is quoted at some length, as this manner of association of disparate mental objects, through a neoteny of proto-drives and proto-intentions, along with the individuation of cognitive targets and elaboration of a complex interior life, is a fairly recent, cultural change in humans, and the

diversity of cognitive targets and complex interior life that results from this process involves a neotenous association process. The diversity of cognitive targets and complex interior life, being so associated, reflects our individuation at a fairly advanced stage of cognitive development, signaling our development as free functioning adults with a complex interior life. Should this neotenous change fail to occur, or occur in an aberrant manner, the disparate associations would be dissociated, and the drives and inwardness would be directed in such a way that they do not move outward into an actual and real world derived from an actual and real self.

The result of such a dysfunction in what seems like a very delicate process could then lead to the schizophrenic syndrome as described by Eugen Bleuler, which we will discuss later, which is fundamentally a dissociation of self and world. Autism would then become an inwardness not connected to proto-drives; ambivalence would be a failure to differentiate the targets of the proto-drives; associations would be disparate; and blunted or restricted affect would reflect the absence of a foundation for the proto-drives that provide the feeling-tone of ideas, self, and objects.

The microgeny of dissociation has already been described [Germine, 2004] in the context of Dissociative Identity or Multiple Personality disorder, as a kind of branching in the conscious self, originating in the potentially polyvalent core of self. The core of self, fundamentally, is not individuated – this process occurs higher in the microgenetic process – and the attainment of a singular self is a process in microgenesis that demands a singular valuation of the object world – unique to the individual, through the process of individuation.

Episodic memory is always related to an individuated self, and adheres at limbic and cortical levels of microgenesis, not at the deeper levels of the core of self. The association of episodic memory and individuation is reflected by the dawn of episodic memory in early childhood, around the period of potty-training, and when we have learned to feed ourselves. These basic functions of feeding and elimination occur far earlier in most mammals, and thus exhibit a remarkable neoteny in humans – which is further reflected in the extended period of development, up to 21 years, when the cranial sutures are fully ossified - and brain growth is completed after a period of dendritic pruning that establishes the fundamental connectivity of the adult brain. Plasticity of the brain is progressively reduced in the process, and the personality can be said to be fully established only in adulthood. An aberrant integration at this point is thus likely to occur, and to be relatively difficult, although perhaps not impossible, to change. One of the principle aims of this paper is to define the parameters of such an aberrant integration in schizophrenia, thereby helping establish the conditions of prevention and perhaps remediation.

As a dissociation of self, schizophrenia has certain affinities to the dissociative disorders, of which the extreme exemplar is Dissociative Identity Disorder [DID]. The changing of this name “Multiple Personality Disorder” was a retreat from the idea that more than one personality can occupy the

same brain, and thus have different memories, which clearly shows the relationship between an individuated self and episodic memory. Such a process defies the strict reduction of mind to brain, to the extent that different personalities may operate with some autonomy in the same brain. DID may be thought of as a central enigma that needs to be solved for a fully integrated mind/brain theory.

A microgenetic approach to hypnotherapy in DID has been described [Germine, 2004]; it involves the theory of the dissociated self as a microgenetic bifurcation, perhaps with each part-self derived from the core, prior to its deliverance to consciousness, as the fragmented alters. Successful treatment by fusion of the dissociated "alter" personalities was achieved, as well as the extinction of hallucinations (we will describe it briefly here). There is quite a large literature on multiples and hypnotherapy of multiples, but fusion generally takes far longer than the 3 months reported here [Germine, 2004].

What is remarkable in this context is the successful hypnotic integration of two or more "alter egos" at the level of the core of self, along with successful anamnesia by hypnotic regression and redirection by age regression to the time of the microgenetic split or dissociation, and the successful treatment of functional hallucinations by hypnotic phylogenetic placement of the hallucinations at the level of silent fish in water, deep in the core of self. Hypnotherapy has not been found useful in schizophrenia, and is highly discouraged. The following case is an example of, at minimum, some usefulness of hypnotic technique in schizophrenia, in an example of a dissociative psychosis, apparently unrelated to what would be considered trauma for an ordinary person, or to any signs and symptoms of Posttraumatic Stress Disorder.

CASE REPORT OF HYPNOTHERAPY IN SCHIZOPHRENIA

What we present here is an unusual case of successful hypnotherapy as a treatment for psychosis due to schizophrenia. Dissociation and fragmentation of the self or ego is a frequent phenomenon in schizophrenia, which might, in some cases, be amenable to this kind of treatment.

For the purpose of confidentiality, some of the details of this case report have been changed. The first person in this report is the second author (MG).

Harold was a 38-year-old man with a history of paranoid schizophrenia back to age 23, when he had a severe psychotic break requiring hospitalization. He had successfully completed high school, and was of normal intelligence. He was employed from age 18 to 22 in a convenience store, and had lived with his mother continuously since birth. He had been hospitalized 6 times for psychosis and command suicidal hallucinations, with his last hospitalization about 1 year prior to the time described in this case report. He had no known history of drug or alcohol abuse or dependence and no known history of clinically significant trauma. He had some history of depression, but it

was in the context of severe psychosis, delusional beliefs, and command hallucinations telling him to kill himself.

Harold had been treated with many typical and atypical antipsychotics, but his psychosis was relatively refractory to medications. Various antidepressants and sleep aids had been tried. At the time of this report he was taking risperidone, 2 mg twice a day, and mirtazapine, 30 mg before bedtime. He had no significant medical illness. I had been seeing Harold every 4 weeks at a county government psychiatric clinic for about four months. He was receiving no other psychotherapeutic services. He generally attended to his self care, but was otherwise dependent on his mother. He had no friends and rarely left his home.

Harold had been fairly stable at baseline with considerable delusions and auditory hallucinations, but no visual or other hallucinations. At the onset of this report he had been brought in on an urgent basis, as he was decompensating, with increased delusions of possession by "spirits" or "people," and increased auditory hallucinations, with some command suicidal hallucinations. He had been sleeping well, per his own report. Harold said he was hearing several voices inside his head, to whom he referred as "people." Some of these "people" or "spirits" had been continuously telling him to kill himself. He said that "they want you to kill yourself so they can go somewhere else." What was decided was to hypnotically have these "people" go somewhere else, outside of the fragmented self-complex.

I asked him to close his eyes, and to take deep, slow breaths. I had never hypnotized Harold before, and I did a fairly rapid, indirect hypnotic induction. I did the induction rapidly as I did not feel he could be in a sustained state of relaxation and focus long enough for a slower induction. I guided him through visualization of a pleasant scene, having him notice all the sights, colors, sounds, and smells, as well as his own hands and clothes. I guided him through another place, by a pond. I suggested that the people would come out of his head when he opened his eyes. Harold began holding his head. After I instructed him to open his eyes, it was clear that he was still in a light trance. He said that the people had left his head and were hovering about the room. I then suggested I open my office door and let them out, which I did, and he said the hovering spirits, some of whom he said were demons that had been tormenting him, had left the room. He then said, "I am inside him," followed by, "That was Tom, if Tom leaves my head he'll die," apparently fearing that this would happen.

A week later Harold returned to my office. I asked him if his suicidal voices had been bothering him. He said that these "people" had left his head during the last visit, and that he had not heard them since because "they don't exist anymore." Harold was still hearing the voice of "Tom," and was still delusional about this. He told me "Tom didn't come out when you asked him to come out." Harold would not let him, since he was a "good" voice.

A month later Harold was still doing well, with no return of the "bad voices." He was still hearing the benevolent voice of "Tom." He said he felt he had "crossed a boundary" during hypnosis, and was still on the other side of that boundary. I gave him a cassette tape with a recorded voice of an indirect induction and suggested that he follow the instruction on the tape, should the voices return. A month later his condition was fundamentally unchanged.

The following month he said that some of the people and voices had returned, but used the tape with good results. Thereafter he learned self-hypnosis, and found it effective, and it remained so over the following 18 months that he was under my care. Harold stated that the hypnotic exercise was far more effective for him than antipsychotic medication. He said this kept him "on the right side" of the boundary he had crossed after the first hypnotic session.

I did the hypnotic intervention in this case because I felt that Harold's voices were dissociated fragments of his own identity. There are a variety of ways, similar to the one used here, of making such fragments "go away," and this is sometimes used as an alternative to fusion in hypnotherapy of dissociative identity disorder [Germine, 2004]. In the latter case, fusion of a fragmented self involved a microgeny-based treatment aimed at the event of dissociation through age-regression, followed by several self-unifying hypnotic sessions utilizing the patient's belief that she had only one soul, and bringing her and her alter into "the garden of the one soul," and doing therapy there. The "garden of the one soul" was, in this instance, a metaphor for the core of self in microgenesis, and is not meant to be applied concretely or literally.

This case history illustrates the potential value of hypnosis or other forms of therapy based on the dissociative model of schizophrenia. Microgenetically, the "real self" prior to fragmentation of "dissociated selves," as people or spirits, is fundamentally restored by externalizing and then symbolically releasing the dissociated fragments. This shows, importantly, that the real self is still present in an earlier phase of microgeny, and may be restored, to some degree, by disposing of the fragments.

TOWARD A SCIENCE OF MICROGENETIC DISSOCIATION

Dissociation of ions, receptor/ligand, antigen/antibody, and other chemical complexes is well known, but generally not thought to bear any relation to dissociation in the mind sciences. However, there does seem to be a kind of correspondence. Fundamentally, there is a dissociation entropy, which, depending on its relationship with association entropy, determines the degree and stability of the dissociated versus the associated states. The rule of thumb is that entropy, or disorder, increases over time, such that an association, in this case the association of self as a single complex across successive re-creations in microgenesis, will be stable if it has a relatively low dissociation entropy. Such a low entropy, in this case, implies that the self is an ordered

function, that must be maintained as such, and that any increase in the dissociation self-entropy would lead to its dissociation. If dissociation entropy of the self-complex exceeds its association entropy, a catastrophic dissociation of the self-complex would occur, and such entropic processes tend, in general, to be irreversible [Prigogine, 1986]. Thus this catastrophic process may be enduring. Perhaps there is a deep pacemaker in the duration of the mental state, and the process is truncated before full actualization of self and world as separate and real phenomena.

There may be many factors involved in such an increase in entropy and decrease in stability of the self-complex over time. This has important microgenetic implications, as well as therapeutic implications aimed specifically at prevention of the catastrophic dissociation of the self-complex either in high-risk individuals or in the schizophrenic prodrome. For example, certain drugs that enable dissociation, which might include stimulants, hallucinogens, alcohol, and marijuana, would be clearly contraindicated in such high-risk individuals.

The core of self, as it arises out of the lower order centers of the brainstem and diencephalon, would be essential to conscious function. The reticular activating system (RAS), at these levels, is essential to conscious process, and its dissociation would be unlikely without a diminution or loss of consciousness. Furthermore, this core is a network of neurons that does not share the functional organization of higher order centers, where dissociation is thought to occur. It is thus that, in the microgenetic model, the RAS does not just play a permissive function in conscious process, as it does in most neurological and neurobiological theory, with consciousness clearly associated with the cerebral cortex, but is actually the root of consciousness, even though it is, itself, unconscious, to the best of our knowledge.

In general, the higher one gets in the caudal to rostral trend of microgenetic process, with the RAS being caudal, the further one is removed from the RAS, and conscious attention in these areas is largely subserved by focused attention, as opposed to the default mode of diffuse or divided attention. Attention seems to be progressively focused by activation from the primary to secondary to tertiary and supratertiary cortices [Posner & Dehaene, 1994]. As we shall see later, the default or divided mode takes precedence over the focused mode in the schizophrenic brain relative to the normal brain. So, it seems that the theory of dissociation entropy fits with both the microgenetic theory of the microgeny of self and the object world, as well as the neurobiological principles of activation and attention.

This kind of dissociated and fragmented self and world thus implies a dissociation entropy, which needs to be understood in the wider terms to which entropy is ordinarily applied. One of the central problems of the life sciences has been to square the observation of order and form with the principle that disorder increases over time according to the Second Law of Thermodynamics. Things have a tendency to decay, or increase in randomness or disorder. Randomness and disorder are described as entropy. The order that is

imposed on randomness is described as negentropy. Entropy relates to the physical concept of energy. In the simplest, thermodynamic terms, heat energy is transformed into entropy as the system acquires more states through the possible distributions of energy. For a closed system, it is very unlikely for the final entropy of a system to be less than the initial entropy.

The brain, however, is not an open system. Energy is continuously being added to the system in the form of activation of electric potential differences, and this energy is continuously being dissipated, primarily as heat and other electromagnetic radiation. Entropy is also increased by metabolic processes, which fundamentally reduces the entropy of glucose by oxidation, and by "noise" in the system, which includes the ever-present energy coming from the quantum vacuum. Fundamentally, entropy is created through the expenditure of free energy, and information is derived by the order that the system imposes on its entropy. The energy, entropy, and negentropy or information of consciousness may be derived from metabolic energy, but also may be derived from the spatio-temporal non-local quantum vacuum, which might otherwise be considered noise. The brain is a self-organizing system that operates under the constraints of critical dependence on initial conditions [Kahn, Krippner, Combs, 2000], and some predictability is necessary for order to occur. Functionally, brain process is fractal [Kahn, Krippner, Combs, 2000]. Self-similarity of dendritic receptive fields is the rule, making the system globally holonomic [Pribram, 1991].

There is a deep correlation between information theory and thermodynamics. In essence, information is negentropy – the difference between the most probable state or maximum entropy and the actual entropy of the state of the system. Probability relates to uncertainty. Information is the reduction of uncertainty, since the probability of the final state is uncertain with respect to the initial state and boundary conditions. Entropy must always increase over time. In the macroscopic behavior of systems, initial order gives rise to increased order and complexity over time, and boundary conditions give rise to increasing complexity and organization as entropy increases over time. This explains the otherwise inexplicable increase in diversity and complexity in evolutionary systems [Brooks & Wiley, 1986; Ayres 1997], in which order and complexity increase as a function of increase in entropy. As we move into dynamical or far from equilibrium, dissipation systems, such as the brain, self-organization becomes the rule.

The critical dependence on initial conditions makes self-organizing systems inherently unpredictable. The operant word here is self. In the brain, this self becomes conscious, and orders the brain further than its intrinsic production of negentropy or information and unpredictable states. Self-consciousness is a reduction of this specific function of uncertainty, described here as the dissociation and association entropies of the self-complex, and so may be called a secondary reduction of uncertainty, dependent on an agent or self that observes or measures the state of the system. The self is, by definition,

a source of order, and a disordered self leads to a disturbance of this order. The self must be one, or this order is disturbed, and must have a holonomic purview of the brain in order to carry out this function.

With this initial definition of terms, we see the broad applicability of thermodynamics and information theory, the concept of negentropy as order or information, and consciousness as the product of a self that is an agent that makes observations or measurements of the brain system, which can be called secondary information. When we use the terms “order” “disorder” and “self” we will implicitly have these concepts of negentropy, entropy, and self-reference in mind. Activation is understood as free energy, which gives rise to entropy, and negentropy as an ordering function applied to entropy. Attention involves both activation, or energy, and focus, or order.

In the next section we will describe the theory of information as it relates to time over successive brain states [Germine 1993]. We implicitly consider order within the brain state with regard to initial conditions and boundary conditions, which include sensory inputs, as well as order between brain states, which include the ordering process of brain states within an interval of time. We then go on consider the ordering parameters of self as it relates to the microgenetic theory of Brown [1996]. Primary information is understood in terms of ordinary clock time, and secondary information, the information of conscious process as well as self-energy, self-entropy, and self-organization are understood as occurring in a holistic sense within the duration of temporal thickness or *internal time*, within which organization in non-local, with no possibility, within this dynamical process, of defining “before” and “after” [Prigogine 1991].

These dynamics clearly apply to the brain, such that this interval of temporal thickness can be theoretically and empirically defined. Atmanspacher and Filk [2003] estimate this interval, across all sensory modalities, to be thirty milliseconds, which, taken as a period of oscillation of brain waves, would be about 33 Hertz or cycles per second, placing the gamma oscillations, at about 40 Hertz, well within this interval. Not only is it these oscillations that are most clearly correlated with conscious process, but, based on the frequency/energy relations, they account for most of the energy expended by the conscious brain. Based on the association of energy with entropy, their dynamics are likely to be the most important ordering parameter in the brain, since ordering of the process is always applied to energy, particularly polarization energy.

Furthermore, the dynamical system involves a non-local or atemporal internal time which applies simultaneously to the entire system, and which involves its entire causal history [Prigogine 1991]. Influences from the future would also be entirely possible in such a non-local internal time, except that they are damped according to dynamical systems theory [Prigogine 1991]. This is of considerable importance to the question of time in microgenetic theory, as applied to the spatial and temporal parameters of the dynamical brain system.

Regarding past and future in dynamical systems such as the brain, the dynamical process is represented schematically in Figure 2. Prigogine explains the process as follows, with reference to the Figure [1980, 213]:

> The distinction between past and future is a kind of primitive concept that in a sense precedes scientific activity… We start with the observer, a living organism who makes the distinction between future and past, and we end with dissipative structures, which contain, as we have seen, a "historical dimension." Therefore, we can now recognize ourselves as a kind of evolved form of dissipative structure and justify in an "objective" way the distinction between the future and the past that was introduced at the start…Note that the transition from one level to the other involves "symmetry breaking"; the existence of irreversible processes on the microsocopic level...and dissipative structures may in turn break the symmetries of space-time.

In the context of dynamic systems, the line that we described in our model of microgenesis as repeated over time is described as a "world line" of the system. It is quite clear that such a "world line" is not peculiar to the self construct, as the mind/brain system is open and must include the "world." The distinction between "worlds" is itself artificial, as we are all in the same world, and the "world," in a quantum-physical sense, can be in no way separate from the self. In dynamical, open systems, we describe the self-world relations in terms of initial conditions and boundary conditions. These boundary conditions include, but are not limited to, the information that we take in through our senses. However, even if we had an arbitrarily large amount of information concerning the initial conditions and boundary conditions, we would still, in principle, be unable to predict the behavior of the system, but only, perhaps, a statistical average or stochastic trajectory of possible trajectories. The predictability becomes stronger in hierarchies of dynamical systems, to such extent that they cohere or are cohesive as a single, dynamical system [Prigogine, 1980].

So, a hierarchical dynamics of the kind expressed in Jason Brown's microgenetic theory is essential; a matrix system of interconnecting sub-systems will not give us the statistical level of predictability of a hierarchical system. Some level of predictability would seem to be necessary for a system that must, itself, make predictions and be predictable within reasonable parameters, as well as for a system capable of realizing a logical and coherent picture of self and the object world. This would involve a long range connectivity of structure and function.

The observer, consciousness, and measurement are fundamental problems that lie at the very heart of dynamical systems theory. The problem is not the determination of a single wave function of a dynamical system from amidst the possibilities that are inherent in the stochastic Schrodinger equa-

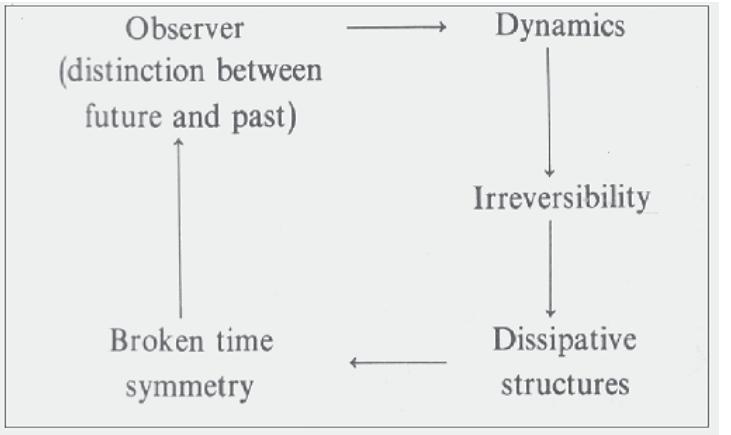

Fig. 2: Fundamental process of a dynamical system, after Prigogine [1980, 213]. Explanation in text

tion, and collapsing them into a single possible wave function or "world." Rather, as recognized by Von Neumann, the very act of observation of a single wave function transforms a pure state, with a single density matrix or statistical distribution of possibilities, into a mixed state, which causes an irreversible increase of entropy. It is thus that observation must enter into the picture if we are to have an irreversible process proceeding in one direction – past to future - and this breaking of temporal symmetry marks the temporal movement forward in an irreversible process called spontaneous symmetry breaking.

It is thus that, in microgenesis, there is a duration of the mental state, proceeding from an essentially timeless "core of self" and actuating at the surface of a duration of temporal thickness as a discontinuous consciousness in time only with the breaking of temporal symmetry. The "core of self" is timeless because it does not actually undergo the localization of time, which occurs only at the surface of consciousness. Prigogine [1980] states: "This is in line with the general philosophy already mentioned that irreversibility is *not* in nature, but in us." Indeed, the controversial idea of Jason Brown (1996) that consciousness or mind fundamentally "deposits" or "creates" time has been long vindicated, but no one has noticed.

Similarly, dynamical systems such as the brain go through "bifurcations" in that they branch into alternative sets of states. It is this process that requires a knowledge of the history of the system, and, as most known dynamical systems are not conscious or even mind-like as we understand it, this knowledge can only be a reiteration of prior bifurcations. In lay terms, if path A bifurcates into paths A or B, it is not possible arrive to arrive at C unless there is knowledge that it has already gone through bifurcation points A and B. The stability of the system then becomes contingent upon the stability and orderliness of bifurcations, and such a stability entails the irreversibility of its bifurcations. Such irreversibility seems to occur, not in nature, but in us. Bifurcations are

very sensitive to macroscopic variables in environmental or boundary conditions [Prigogine 1980], thus the appeal of the "instability of the homogeneous" derived in nature. A conscious process or observer involves the irreversibility of the increase in entropy that follows observation, which alone, as per Fig. 2, and the accompanying explanation, marks the time of the irreversible breaking of the inherent symmetry of time.

What we are discussing with the ordering process of consciousness is specifically related to the ordering derived from self, as a unitary agent. We have called this secondary information, and it is such information that is proposed to give rise to the content of consciousness, or to the totality of the unconsciousness/consciousness continuum. We need, however, at least a provisional mechanism by which such information may be generated. In Brown [1996], this mechanism would involve a temporal thickness of the process of microgenesis of the mental state, such that time within the mental state is not, in a strict sense, sequentialized. In dynamical systems, this corresponds to internal time, which is a non-local time involved in the generation of the final state from the initial state [Prigogine, 1986]. In this representation [245]: "Past and present are separated by a kind of transition layer," which is proposed to be the temporal thickness of the brain state in Brown [1996]. Process within this temporal duration cannot be subdivided into "before" and "after," and so involves a separate kind of causality where integration occurs within a duration, rather than a succession of immediately adjacent past to present in "clock time" [Prigogine, 1986]. This sort of process is demanded by the structure of dynamic systems process [Prigogine, 1986]. Although such process has been emphasized as key to the understanding of psychology and microgenesis [Germine, 1997], there seems to have been little application in the field.

Here we follow the microgenetic view of the core of self, that manifests progressively from the unconscious through consciousness, with consciousness lying, in effect, at the surface of the process, but capable of being exposed at deeper levels that are normally unconscious. This is, in fact, the fundamental theory of schizophrenia as a deficit-syndrome in the microgeny of self and world, and, neurobiologically, as a disconnection syndrome [Takahashi et al., 2010].

FURTHER NEUROBIOLOGICAL CONSIDERATIONS

In our probing of the physical foundation of the fundamental tenets of microgenesis, we have found a remarkable confluence with dynamic systems theory, which validates the following elements:

1) a global, simultaneous interval, "internal time" corresponding to the temporal thickness or period of simultaneity in microgenesis,

2) a demand for historicity in the evolution of a dynamical system, which can only be framed in terms of the recapitulation theory of the microgenetic state,
3) the demand for a hierarchical functional process in order to maintain stability and some measure of predictability,
4) the fundamental role of self in the process, in the form of the observer that deposits or creates time at the end of the temporal duration of internal time,
5) the generalization of basic microgenetic theory, as outlined in the previous points, to inorganic, dynamical systems. In the generalization of the theory, we find it more fundamental than its neurological underpinnings, and, in fact, to precede and perhaps make possible the very existence and evolution of the human mind. However, our exploration of the neurobiology of microgenesis, and how it now applies to schizophrenia, demands further development.

We have briefly mentioned the physical basis for information as it related to energy, entropy, and negentropy – three closely related concepts. In a simplistic formulation of the information processing of the mind/brain [Germine, 1993], conscious information processing is a linear function of time. Linearity lends further support to microgenetic theory, as the order of a single state must be fully reiterative for such temporal binding of information to occur. The reason for this is that it is only in this way that the complexity of the system exponentiates, and the log of an exponential function is linear, as demanded by the basic physical relationship between the log of complexity or number of constituent possible states, entropy, and information. This linearity is supported by experimental data in terms of processes perhaps up to ten seconds in duration [Germine, 1993]. Schizophrenia is postulated to be the result of a disordered process, relating to the terms of ordered complexity over time [Germine, 1993]. Information is further a function of the ordered complexity of the system, which is dependent on the energy and energy distribution of the system. We find this reflected in the neurobiological literature, and with particular reference to the EEG, so we must examine this literature, particularly as it applies to schizophrenia.

Firstly, and most importantly, we must examine the entropy, or potential information, of the microgenetic process as it relates to the developing brain, which establishes the terms of microgeneny. What we find is that, in the theoretical model of development [Bergstrom, 1969], the genetic span extends from a primitive core, represented by the reticular network in the brainstem and thalamus, which has a relatively random geometry, and that this core is surrounded by [139] “more highly developed shells with increasing structural order in the connections between structural units.” The brain process is then hierarchical in the development from low grade to high grade entropy, with higher grade entropy containing a higher proportion of negentropy, negative entropy, or information [Bergstrom, 1969]. It is important to note, at this point,

that the total entropy is divided into positive and negative entropy, both derived from the relative disorder and order inherent in the amount and distribution of energy, with the order or negentropy arising as a result of the order of initial conditions, boundary conditions, and conscious process itself. This model is fully coherent with Pribram's holonomic theory of brain dynamics and Jason Brown's theory of microgenesis [Germine, 1993]. Most importantly, the overall increase in entropy is a function of the act of observation, which sets the parameters for increased entropy and the localization and movement of time, as we have seen in our review of dynamical systems theory. It is also important to note that the core, through activation of higher levels, is the essential governor of ordered energy. Bergstrom goes on to explain [1969, 139]: "This implies that the genetic span in the brain is represented as a nonstable domain, which extends structurally from the reticular core to the cerebral cortex, and functionally from the maximum entropy to the maximum negentropy of the system." Thus information capacity increases in the developmental hierarchy of the system [Bergstrom, 1969], in a bottom-up hierarchy. The converse process, from the top-down, would, in this model, lead to an irreversible loss of information and instability of the system.

Complexity is a function of entropy and negentropy. Entropy arises in the "number of states of a system that result from interactions among its elements" [Tononi & Edelman, 1988]. The log of the potential of this number of states, or microstates, directly relates to information, such that exponentiation through changes in state will be a linear function. Microstates cohere through the observation of observationally equivalent states, which are grouped together as macrostates [Germine, 1993], and are inherent in the parameters of observation [Prigogine 1980]. In this view, time is an operator, not a dimension, as is entropy. These operators are functions that constrain the states of the system, but the observation of entropy and time is complementary, meaning that precision in the parameters of one leads to uncertainty in the parameters of the other. This is a remarkable confluence between dynamical systems theory and quantum theory, which includes the fundamental non-locality that we have already discussed [Prigogine, 1980].

This informational model is, in essence, schematic, and much more complex informational models have been developed for experimental purposes [Lee et al., 2003; Takahashi et al., 2010]. Such models, however, do not seem to involve the log-exponentiation, or time-linear component that is inherent in empirical studies of actual conscious information studies [Germine 1993], and which are implied in the reiteration process that is inherent in microgenesis [Brown 2000]. This reiteration process is inherent in dynamical systems theory [Prigogine 1980], and can only be addressed in the inherent generalization of microgenesis to the lawful properties of dynamical systems. However, the view of internal time, which this generalization entails, does not seem to be carried over to empirical research, in which view time strictly described in the classical sense of "clock time."

The problems presented by any theory of mind that does not include the "observer" are inherent in the actual role of the observer in any formulation of dynamical systems, as we have outlined. As described by Walter Freeman [2001, 33], brains are "chaotic, unstable, nonlinear [dynamically], non-stationary, non-Gaussian, asynchronous, noisy, unpredictable in fine grain, yet undeniably they are among the most successful devices that billions of years of evolution has produced." This is quite a paradox, which can only be explained in the view of microgenesis as a general theory of dynamical systems *preceding* biotic evolution, and, in essence, being its pre-condition. Regarding the EEG, Freeman [2001, 44] explains: "The EEG is the noise made by the millions of neurons that constitute it." As Freeman [2001] has aptly noted, the EEG is, for all practical purposes, a record of dendritic currents in the forebrain. Freeman postulates that it is the noise that is essential to the global, mesoscopic and collective ordering parameter, with self-organization emerging from background noise perturbed by sensory stimuli, thereby giving rise, on the mesoscopic scale, to perception [2001].

Whether or not the EEG oscillations are accorded to "noise," or not, the empirically-derived relations of the gamma oscillations are none-the-less relevant. Synchronous gamma activity on the EEG, ranging from thirty to ninety Hertz, seems to be most the most clearly associated corollary of the binding of cortical areas, and has been described as the multimodal foundation for all information processing in the brain [Lee et al., 2003]. The gamma oscillations seem to be a product of thalamo-cortical arousal, and the Hebbian synaptic plasticity of the brain, or long-term potentiation, has been postulated to be a result of gamma synchrony [Lee et al., 2003]. Some studies have shown a decrease of gamma activity in schizophrenia. Abnormal synchrony and intensity of the gamma oscillations, found in the brains of schizophrenics as compared to controls, has been speculatively related to a kind of "cognitive dysmetria" [Lee et al., 2003], and it has been proposed that impaired reality testing in schizophrenia is the result of frankly impaired connectivity due to disconnection of synchronous gamma oscillations [Lee et al., 2003].

The gamma oscilliations seem to be modulated or carried on the much lower frequency theta, four to eight Hertz, oscillations [Lee et al. 2003; Huchzermeyer, 2010]. The theta modulation of gamma oscillations has been proposed to provide the temporal organization of higher brain functions [Huchzermeyer 2010]. It has been noted that the gamma oscillations are exquisitely sensitive to oxygen, and expend near-maximum mitochondrial energy producing capacity, which is through oxidation of glucose and production of ATP [Huchzermever 2010]. Fundamentally, neuroimaging technologies, which have been used to describe the disconnection and aberrant connectivity of schizophrenia, including fMRI, PET, and SPECT scanning, largely reflect the energy utilization of gamma oscillations in dendrites.

Hyperactivity and hyperconnectivity of the default network in the brain under fMRI have been established in rest versus working-memory task per-

formance in schizophrenics with early-phase schizophrenia and their first-degree relatives. Versus controls, schizophrenic patients showed impaired task-dependent suppression of activation of the default network, including the medial prefrontal cortex (MPFC) and posterior cingulate cortex/precuneus. Patients and relatives had significant reduction in task-related MPFC suppression, and greater activation of the right dorsolateral prefrontal cortex. During rest and task, patients and first degree relatives showed high functional connectivity and hyperconnectivity in the default network. Hyperconnectivity characterizes a system with high entropy and compromised processing capacity relative to highly-ordered small world networks. Psychopathology correlated with default network hyperconnectivity during rest and task performance in the patients. Patients also exhibited reduced anticorrelation between MPFC and DLPFC (Whitfield-Gabrieli et. al., 2009).

MICROGENETIC CONSIDERATIONS IN SCHIZOPHRENIA

The microgenetic theory of schizophrenia has been outlined by Pachalska et al. [2004]. A fundamental deficit of self and agency exists, in that [Pachalska et al., 2004, 2008] “when the mental formation of the self and the world is perturbed by schizophrenia, action and perception become confused, fully interchangeable [Brown, 2002].”

The microgenetic model is based primarily on observations of neurological deficit syndromes such as aphasia, apraxia, and agnosia [Brown, 1972, 1988]. The progression of the process generally runs from primary, secondary, tertiary, to supratertiary cortices. So, for example, if we have a total loss in the function of the primary visual cortex, all subsequent processes of visual processing of consciousness of the object are lost, as well as the associated process, running roughly in the caudal to rostral trend of the neuroaxis, through functions of the multimodal association areas, such as naming the object, evaluating the object, and reaching out and grasping the object. Attention is focused progressively as the object is actualized, and this attention remains attached to the core of self. In the passive or default mood activation through the successive levels of process is not sustained by activation, attention is not progressively held through higher order process, and feature recognition is compromised [Posner and Dehaene, 1994].

In the context of schizophrenia, we will focus on two key areas, which are interrelated. Recently, the schizophrenia spectrum disorders, including schizophrenia and schizotypal personality disorder, have been recognized as an aggregation of self-disorders, as defined by abnormities in self-awareness [Raballo et al., 2009]. There is a wealth of earlier literature along these lines [Raballo et al., 2009; Sass and Parnas, 2003]. Dementia praecox was described by Kraepelin as something like “an orchestra without a conductor” with a “loss of inner unity” of consciousness, and this “was echoed in the writ-

ings of nearly all prominent classic researchers" including Eugen Bleuler, as well as many recent authors, including the popular author, Ronald D. Laing [Raballo et al., 2009].

A Self-Disorder Scale has now been developed and validated [Raballo et. al, 2009]. It is noteworthy that many of the items on this scale could be considered dissociative, particularly reflecting a dissociation of self. Using DSM-III R diagnostic criteria, a total of 305 subjects were scored, 29 with schizophrenia, 61 with schizotypal personality disorder, 102 with other mental disorders, and 56 normal controls, with normal controls as a reference category. Scores and p-values relative to normal controls were as follows:

- schizophrenia 5.6, <0.001,
- schizotypal personality disorder 4.2, <0.001,
- other mental disorder 1.2, 0.018.

Scores with respect to no mental disorder were 3 times higher in other mental disorder, 11 times higher in schizotypal personality disorder, and 21 times higher in schizophrenia. On Bonferroni correction the scores were schizophrenia = schizotypal > other mental disorders = normal controls. Using a logistic regression model predicting the presence or absence of self disorder, goodness of fit in schizophrenia spectrum disorder was significant at $p < 0.0001$. It seems this self-disorder is characteristic of schizophrenia spectrum, and holds considerable promise for early detection and for further research.

Many of the items on the scale reflect default or passive-mode thinking. An example of default mode or passive attention is described in the self-ordered statement "Thinking is simply going on in my head, with me as a spectator" [Raballo et al., 2009].

In a further study [Raballo and Parnas, 2010] self-disorder scores were compared on the basis of candidate vulnerability phenotype in 218 individuals in non-psychotic, high risk subjects. An incremental, significant increase in self-disorder score versus controls was found ranging from no mental illness to schizotypal personality disorder, through the intermediates of no mental disorder with schizotypal traits and other personality disorders.

In summation, then, self-disorder symptoms are important variables in schizophrenia spectrum disorders, but also are significantly increased to various degrees in genetically-high risk cohorts, including individuals with no mental disorder and no mental disorder with schizotypal traits, as well as other personality disorders. Deficits in suppression of the default mode of attention are present in schizophrenic patients as well as their first degree relatives. Dissociation, including the important aspects of derealization and depersonalization, has been emphasized in the theory of schizophrenia [Markowitz et al., eds, 2008, Scharfetti 2008], and this phenomena may be important in the development of schizophrenia, sharing some features with the personality disorders and with DID or Multiple Personality Disorder, as shown in Figure 3.

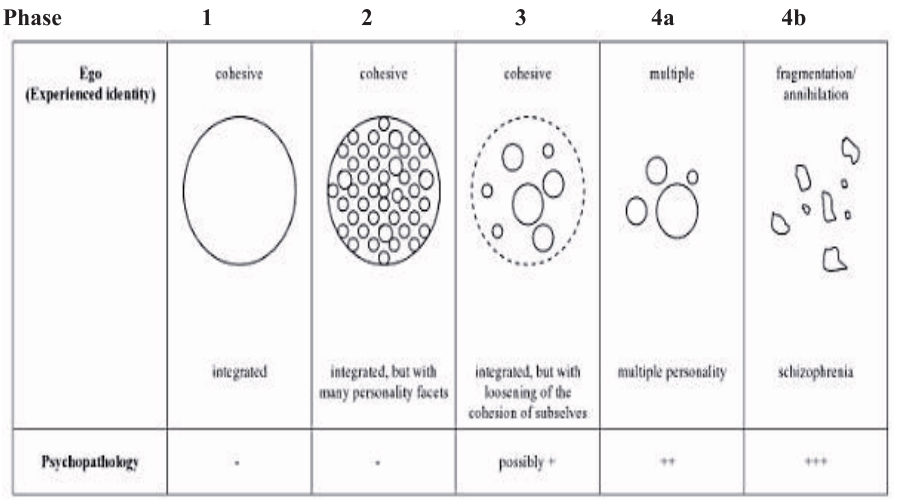

Fig. 3. Schematic representation of the dissociative model of schizophrenia and other mental disorders, after Scharfetti [2008]

The ego here is taken as the self-complex. The oval represents the cohesion or association entropy, with fragmentation reflected by smaller ovals (phases 1 to 4a) and irregular fragments (phase 4b) occurring as dissociation entropy increases. Phase 1 is the cohesive, fully integrated self-complex, phase 2 is the dissociated but cohesive self-complex, phase 3 is the phase of diminished cohesion of association entropy and increased fragmentation, phase 4a shows a loss of cohesion of the self-complex with ordered fragmentation seen in DID or multiple personality, and phase 4b the alternate pathway with loss of cohesion and incomplete irregular fragmentation seen in schizophrenia, represented by irregular shapes. In certain cases, one or more alters, represented by ovals in phase 4a, may be psychotic and incomplete, as shown by the irregular fragments in phase 4b.

PSYCHODYNAMIC SYNTHESIS

Directed attention, which suppresses the default or passive attention mode, is a key feature of schizophrenia that relates to dissociation, which is represented by many elements in the Self-disorder scale, such as thought block and emptiness and strangeness and anonymity of thoughts. Apart from this, the self-absorption or autism that is one of Bleuler's cardinal symptoms of schizophrenia is a reflection of loss of self direction to the object world and would seem to relate to deficits in suppression of the default mood. This would follow from the microgenetic model in that the perception of object world arises from an intact self and its differentiation in consciousness to self-complex and object world. The arrested and fragmented self-complex, in microgenetic terms, leads to a profound disturbance in the process.

The emergence of consciousness involves progressive ordering, or reduction of uncertainty, such as to create levels of consciousness, well known in the fields of neurology, neuropsychology, and anesthesiology. This reduction of uncertainty translates into ordering and information, and this information is the content of consciousness. Its connection with self starts at an early stage of microgenesis, in the caudal portion of the brain's neuroaxis, in the early part of our development, and in the early course of evolution, all of which are reiterated in microgenesis. The agent is associated with the content of consciousness because the ordering process of the brain state is reflective of the ordering process through which the agent individuates, continuously and reiteratively. Losing agency from one moment to the next, through fragmentation, ultimately, of the conscious self, leads to disorganization and derailment, hallmarks of psychosis. The narrow boundaries needed to maintain a self-complex that unfolds over several mental states are boundaries of the integrity of the self and of the self-complex. Thus there is an association of psychosis and concreteness, or lack of abstraction. The association of consciousness with a conscious self-complex is quite clear in cases of multiple personality or dissociative identity, where conscious information is divided between two or more self-complexes acting within the same brain [Germine, 2004].

The idea that consciousness or conscious information is a reduction in uncertainty places certain demands upon our theoretical constructs of uncertainty, subjectivity, and intentionality. The non-locality and uncertainty of dynamical systems is stochastic or statistical, and, ultimately, some concept of a non-local observer must be added to describe the system, as shown in Figure 2 and the previous discussion. If we look at quantum field theory (QFT) we find that the dynamical system has a characteristic set of vacuum states or vacua, and that selection from among these vacua is essential to the change in dynamical states. The theory of the quantum vacuum in QFT as it relates to dynamical systems is beyond the scope of this paper, but its applicability to the problem deserves some mention for the interested reader.

The fundamentals of QFT are described in detail by Auyang [1995}. Of particular note is the concept of time and permanence [Auyang, 1995, 170]:

> Permanence means the inapplicability of the concept of change and hence of time…The primitive spatio-temporal structure is permanent; it is independent of temporal concepts. It contains the time dimension as one aspect and makes possible the introduction of a time parameter, but is itself beyond time and change.

Auyang describes the local state of the dynamical system, *M,* as the individuation of events in the field. She goes on to state [1995, 170}:

> M is a continuum of points, which are the numerical identities of events in the world. The number of points in M and hence the number of events

> in the world are as permanent as M….The permanence of numerical identities should not to be mistaken for a conservation law of some kind; it is more fundamental.

It is explained that past, present, and future are tense words inapplicable to Quantum Field Theory, which overrides and replaces Quantum Mechanics. Only the relative concepts of before, simultaneous, and after apply. These terms specify sequence, where time is a parameter mapped onto the tenseless or permanent manifold of *M* as a line or curve. There is no inherent notion in physics that sequences on the line or curve are temporal. They are, in fact, permanent, and space and time are parameters that are associated with events and the notion of change. The curve is itself formed by events which are permanent and do not involve the notion of change that underlies our perception of time [Auyang 1995]. This particular feature, along with features of the dynamical system already discussed, would support the notion that microgenetic process includes the entire process as it proceeds in development and evolution. In the latter case, the world-line is conceived as the evolutionary history of the organisism in its relation to the world or environment.

The breaking of symmetry of the vacuum, or spontaneous symmetry breaking, is an irreversible process whereby the process can lead only from past to future. Thus the dynamical system is time-creating in this view, just as

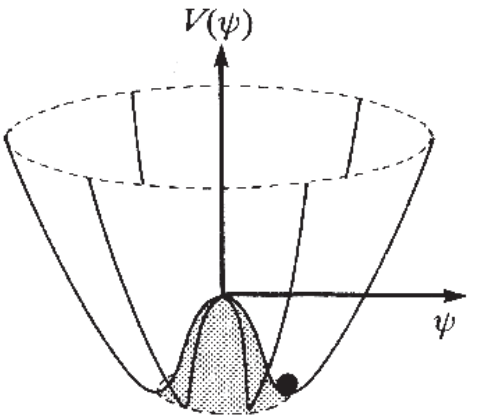

Fig. 4. Phase diagram of the local or non-spatial-temporal symmetry and symmetry transformations of a dynamical system in quantum field theory. V(ψ) is the effective potential prior to symmetry breaking, and ψ is an operator, which modifies the entire dynamical system in a global fashion. In quantum fields, position is not an observable, but a parameter with the same status as that of time. The Higgs field restructures the ground state of the system, creating the elevation or hill in the center of the bowl-like phase space, called the local degenerate vacuum of the system. Interactions with the system cause the rotational symmetry leading the ground state, represented by the black dot, to move from the center of the rotationally symmetrical phase diagram to a minimum or ground state. As the ground state represented by the black dot is not symmetrical with the phase space, symmetry in broken or hidden. Diagram after Auyang [1995, 54].

it is in the purely dynamical systems model (Figure 2), and in the microgenetic model. The dynamical state of the system or brain is, at each moment, a point on a permanent world line, but it has yet another intrinsic unpredictability, in that the point of the ground state that the system assumes with each event can be variable. Prigogine [2002] has emphasized the role of unpredictability in dynamical systems as a key factor in time-symmetry breaking, in that initial conditions cannot, in principle, predict final conditions. It is only the introduction of a subject or what we have called the self-construct that can provide the requisite order, and this is, then, what we have called secondary order, the ordering process of consciousness and of the observer or self-construct. All of these lines of evidence seem to converge on the fundamental tenets of microgenesis, as previously outlined.

The actual contribution of the energy arising out of the vacuum would be otherwise classified as "noise," and it has variously been speculated in physics that such vacuum noise in the principle source of entropy in systems, congruent with our formulation. Order is introduced, as what we have called secondary order, in the spontaneous breaking of symmetry, in which the event becomes actual. It should be emphasized that the phase space of the vacuum is not spatio-temporal, but consists in parameters describing the state space of the dynamical system. Consciousness and mind are then internal to this phase space within the vacuum, representing the state of the system as a whole at every point within the system. There is no need to externalize the dynamics of mind and consciousness in this formulation to specific phenomena with the brain, its structure, or its function, except insofar as these phenomena are ingredient to the brain state. This formulation solves both the binding problem and the mind/brain interaction problem, the key problems in the theory of consciousness itself. In these terms, the whole to part specification emphasized in microgenesis (Brown, 1996) becomes sensible.

DISCUSSION AND CONCLUSION

There are likely to be multiple factors or variables, to some extent interrelated, in the microgenetic etiology of schizophrenia. Moreover, as we have seen, the schizophrenic syndrome involves a continuum and, to some degree, neurobiological and other differences in function occur in a spectrum, and some of the same abnormalities seen in the spectrum are shared by first degree relatives. Beyond this, schizophrenia is not monolithic, but may include a number of types, among which some may be more or less dissociative. Further, within the general microgenetic paradigm of schizophrenia, we are entitled to employ multiple working hypotheses, as the deep questions that we must address may not admit to an easy solution.

The binding of the system of the mind/brain, a mysterious problem that is not fully answered by the concrete notion of gamma coherence, would, according to this theory, be fully realized by the terms under which the sys-

tem evolves in the non-spatio-temporal phenomenon of the breaking of symmetry in the dynamical system, which would integrate the simultaneous duration. This process, its reproducibility, its order, and its properties may underlie the conditions that allow the binding of gamma oscillations in such manner as they become the basis for the Hebbian strengthening of interconnected networks of coherent gamma oscillation to evolve. In this case, the apparent aberrant connectivity of the brain in schizophrenia, as well as the self-disorder caused by a lack an abiding self-construct, might have its origins in properties of the self-replication that adheres in the order of this reiterative process.

The prevalence of self-disordered perception and cognitions has been recently revived as a central feature of schizophrenic process, and characterizes patients with schizophrenia-spectrum disorders, including early schizophrenia and schizotypal personality disorder, from patients with other mental disorders and no mental disorders. Applying the theory of microgenesis, with its deepest roots in the unconscious core of self, the self-disordered process seems to apply to the loss of selective attention and the failure to suppress default or passive attentional processes in working memory tests, as evidenced by the hyperactivity and hyperconnectivity of default processes of the associated regions of the brain. Here we have drawn attention to the holonomic theory of brain dynamics of Pribram, which suggests that the uncertainty that is reduced in conscious process could be ingredient to the conscious process itself, and so the representation of such information could be expressed on a global basis to the reduction of such uncertainty in polarization energy of the brain state as it relates to energy, entropy, and negentropy of the brain state and its concatenation over time.

Parcellation of experience from whole to part in the upward genesis of mental process from the core of self to the conscious self and object world in the microgenetic theory of Jason Brown is offered as a unifying basis for both self-disordered signs and symptoms of schizophrenia and aberrations in the structure of directed attention among schizophrenic patients and their first degree relatives.

The dynamical properties of holism or non-locality and the individual duration of time in internal states are offered as an underlying physical mechanism for microgenesis, which must be established for further theoretical elaboration of the concept. A case study is offered as evidence for a dissociative etiology of schizophrenia, and it is shown that this dissociation may be amenable to treatment. Dissociation of the self-complex in the upward movement of microgenesis is connected to the self-disorder evident in schizophrenia, the aberrant dominance of the default mode of attention, the dynamics of internal time and non-locality in dynamical systems, and the development elements of the schizophrenic break from reality.

The important concepts of dissociation and association entropy of the self-construct are introduced here for the first time, to our knowledge, and a simple formula for the schizophrenic break from reality is proposed. This formu-

la is that, where dissociation entropy exceeds association entropy of the self-complex, the self-complex will itself be dissociated, leading to the schizophrenic break. Due to irreversible features of dynamical system, this break will be catastrophic and tend to be enduring. Therefore, remediation must involve prevention of such self-dissociation in high risk and prodromal individuals. There are many other social and developmental variables that may be involved, which can be elaborated in the microgenetic model, and which may involve overall social cohesion within the cultural milieu and use of substances that may enable the catastrophic dissociation and apparently traumatic loss of a "real self" in an adequately valuated object world.

Further work is certainly needed for the fuller description and explanatory model of schizophrenic processes and types. Philosophic biases seem to have led us to a very concrete view of the mind that is based on signals transmitted through "wires" and thereby constituting the basis of experience as an epiphemenon, rather than a real theory of the information content of consciousness and its connection to a genuine self-complex. Hopefully, we have made some progress here in basing mental function on the actual physical underpinnings of information science. The absence of a clear information theory of psychodynamic processes has led to an explanatory gap between metapsychology and neurobiology, and, hopefully, we have made some progress in closing this gap, which seems to have led to very little real progress in the overall conceptualization of consciousness and mind.

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