THE LOSS OF NEOCORTICAL FUNCTION:
SUBCORTICAL MEDIATION OF MEMORY AND HABIT FORMATION

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The purpose of this paper is to examine the following:
1) the loss of neocortical function following trauma,
2) the abrogation of cortical control in temporarily overriding subcortical messages concerning noxious stimuli,
3) the formation of subcortically mediated habits resembling learned instincts (instinct-training interlocking) (Campbell, 1987) that are used in the service of dissociation,
4) the reduction of the cortex to ratifying subcortical activity,
5) conflicts between cortical learning, subcortical learning and inbuilt phylogenetic learning (instincts), and finally
6) some therapeutic strategies for freeing chronically traumatized people from rigid, stereotypical retraumatization by restoring the capacity for conscious, rational choice.

In an earlier paper (Smith, 1987), I looked at how trauma could disrupt or shut down the neocortical capacities to perceive alternate choices, reevaluate the meaning of events and to direct responses that maintain homeostasis and preserve existence.

Using Laing's concept of ontological security, I moved from a psycho-philosophical explanation of a loss of fundamental well-being to a psycho-physiological description of trauma and shock. Laing saw ontological insecurity as a progressive loss of connectedness starting with a partial connection between the synthetic self and others and reaching a hypothetical end state of "chaotic nonentity," a total loss of connection between the self and others.

This parallels a description of a descent into a near or complete state of shock. Trauma (optimal elevation of the SNS by pain or threat) proceeds for only a short time. Without a successful resolution (escape or cessation of traumatic stimuli), sympathetic arousal rapidly ends and there is a precipitous collapse into a state of confusion, disorientation, stupor and shock.

Dissociation is used to protect neocortical capacity so that a chronically traumatized child can still reason and think, and hopefully find a way to confront and integrate the sense of insecurity and feelings of pain that are continuously threatening to break into consciousness.

Through time, brutalized children learn to dissociate from early trauma by combining functional techniques, exogenous substances and endogenous chemicals. Many people learn to use the discomfort and pain of myofasciitis (that comes from prolonged hypervigilance and muscle bracing) to distract them from recognizing deeper pain.

The work of Janov and Holden (1975) may help to shed more light on the process of repressing painful feelings resulting from childhood trauma. Janov makes an important distinction between "consciousness" and "awareness." Consciousness is a state of the

organism, not a brain phenomenon alone. Awareness is a moment-to-moment process which always has a content. Janov writes that when content is directly related to subconscious processes, there is consciousness. When content is unrelated and only symbolically derived from the subconscious, there is only awareness. Awareness denotes disconnected thought processes while consciousness denotes when those processes are fully connected. For Janov, mental illness is an altered state of consciousness. "Painful realities are automatically and reflexively withheld from consciousness by certain structures of the brain..." (p. 2) "Unconsciousness represents a breakdown in the integrative capacities of the brain..." (p. 3) When the integrative system is overwhelmed by the blocked pain of early trauma, it becomes shunted into alternate cerebral pathways rendering the person, in that sense, unconscious. "Curing mental illness means altering consciousness so that awareness and consciousness merge rather than diverge as they do in neurosis and psychosis. This means changing the integrative relationships within the nervous system. Without that basic and profound change, I submit, there can be no cure for mental illness." (p. 5)

Janov continues that the reticular activating system supplies the "energy" of feeling and when it is disconnected from higher centers, this energy is experienced as "amorphous tension." Only certain areas of the cortex can control the activity of the reticular system. One of these is the frontal cortex. The limbic system, situated between the cortex and reticular system, integrates input from both the frontal cortex and the reticular system. Janov notes that a good "fronto-limbic connection" can stop the reticular activation. Conversely, childhood pain, stored in the limbic system can only be defused by a frontal connection. Thus, childhood trauma is always pushing to get through to conscious awareness while the frontal-limbic connection is waging a war to keep the pain repressed.

Kolb and Whishaw (1990) describe Luria's concept of cortical structure and function. In a normally functioning person, the posterior sensory unit of the cortex receives, elaborates and integrates sensory input. For action to take place, activity from the tertiary zones of the sensory unit is sent to the tertiary zone of the frontal motor unit where execution is initiated. The sensory unit passes the information to the hippocampus for memory processing and to the amygdala for emotional assessment. The cortical events could lead to a planned motor response.

In a traumatized person, sense information about early trauma would not be able to pass through this circuit and no planned action for ending the pain could be taken.

Mishkin and Appenzeller (1987), in discussing memory formation, discovered that the loss of the amygdala and hippocampus together caused a loss of memory for a stimulus-reward task in monkeys. Damage to the areas of the diencephalon which receives fibers from the amygdala and hippocampus also severely impaired memory.

Mishkin proposed that two broad circuits, rooted in the amygdala and hippocampus respectively, are responsible for many kinds of cognitive learning -- the capacity to recognize a familiar object, recall its sensory qualities, remember its location and attach emotional significance.

However, he also believes there is a second type of learning, one he calls habit. This is based on stimulus-response repetition. It is non-cognitive, based Mishkin says on the memory of pairing, not knowledge. He notes that the striatum is far older that the cortex or limbic system. The striatum receives projections from many parts of the cortex (including sensory systems) and sends fibers to the motor parts of the brain. It is, therefore, well-suited for providing a relatively direct link between stimulus and action.

Cools and van der Bercken (1977) list Powers' sensory "input" levels: (1) intensity signals, (2) sensation signals, (3) configurations (spatial), (4) transition signals -- the rate at which a configuration changes, (5) sequence signals -- "acts" such as walking or climbing, and (6) relationship signals -- specific connections between acts and lower-order signals. On the basis of lesion studies, the authors conclude that the neostriatum "forms part of a system in which incoming signals are compared with previously established target values or reference signals; the reference signals are assumed to represent the links between two or more "behavioural acts" forming an integrated program.... Referring to the model described in the previous section, this hypothesis identifies the neostriatum as a neural substrate involved in the control of at least sixth-order signals. The reference signal indicates what is to be done when a given act or "subroutine" is completed; the latter information is carried by the input signals reaching this level. When the error signal being the weighted sum of the input and reference signals is equal to zero, the output function goes on to produce detailed reference signals for lower-order systems, i.e. for sequence, transition, configuration, sensation and intensity systems in the correct order. The resulting consequences at the behavioural level is the execution of behavioural programs..."

Louilot, et al. (1989) agree that the basal ganglia (striatum and globus pallidus) is the system involved in the performance of motor acts.

Perez-Ruiz and Prado-Alcala (1988) state "There is a large body of evidence which strongly suggests that the striatum is critically involved in memory processes.... Most studies have shown that interference with striatal neural activity greatly interferes with the retention and early maintenance stages of instrumental responses which have been acquired through a relatively small number of training trials or, in the case of one-trial passive avoidance, through the administration of a negative reinforcer of low intensity...

"Taken together, the data reviewed above support the hypotheses that... the integrity of the striatum is essential for the acquisition and early maintenance stages of instrumental learning...." (p. 599)

Thus, there is considerable evidence that the striatum is the mechanism by which not only simple S-R connections are formed and maintained but by which operant behaviors can also be formed.

There is also a third kind of memory and learning, instinctive species learning, in this context the avoidance of pain. Mishkin notes that cognitive learning and noncognitive habituation can be in conflict. In a traumatized, dissociated person, all three types of learning are in conflict.

Methods of dissociation primarily involve habituated retraumatization -- pain is used to cover deeper primal pain. The cognitive knowledge -- expectation system - has no experience of successfully processing buried traumatic material. Thus, no rational plan can be formed to accomplish that task. Furthermore, the capacity for rational thought is constantly disrupted by the continuing uppushing pain and the confusion and shock of habitual retraumatization. Finally, there is a belief about powerlessness; there is no escape.

The subcortical striatum, I propose, mediates the dissociative habits. When there is a breech in hypervigilance or a relaxation of systemic tension, the primal pain threatens to break through. This is the stimulus for restoring the defensive structure. Artificial arousal and analgesia through the relatively automatic use of a variety of substances would also seem to be controlled by the striatum. Thus, the contracted and rigid cognitive system is relegated to ratifying harmful dissociative habits which in turn conflict with the instinctive need to end the pain.

Incidentally, the neuroanatomical model of oppositional forces outlined in this paper can perhaps be used to explain the phenomena of learned helplessness, neophobia (fear of the new), and counterphobic reactions (when a person seeks the presence of a feared object or situation).

A possible direction for ending this pathetic stalemate would be to slowly extinguish the dissociative habits, carefully acknowledge and process both the pain of withdrawal and the pain of the past, and by reassuring the client that with the gradual clearing of the neocortex, the mind can be used in the rational service of recovery.

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