NON-INVASIVE METHODOLOGIES OF STUDYING NEUROLOGICAL CORRELATES OF HUMAN MENTAL STATES, IN PARTICULAR THOSE DURING PSYCHOTHERAPY — A REVIEW OF RECENT LITERATURE

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I. Introduction

A. An Overview of the Development of this area in the field.

Direct investigations of the objective physiological correlates of ongoing human psychological experience began only four decades ago with Penfield's famous mappings of the sensori-motor cortex. Today, a cursory review of the reference periodical: "Psychological Abstracts" reveals at least 20 published researches per month from around the world. Topics range from the use of portable EEG recorders on neonates, to how athletes can train their brains to develop concentration and to rest better. We have come a long way in studying the physiology of ongoing human experience.

Concurrent with the broadening of this field of research has been the sophistication of the tools used. By far EEG is the most widespread and most used method for recording data. Among research tools it is one of the least invasive and it has evolved rapidly. For example, presently there is at least one kind of portable 24 hour EEG machine that the patient can wear much like a 'Walkman' portable radio. This is in contrast to the early laboratory machines from 30 years ago, which are still very much in use and which require a room for the machine, the patient and the bed the patient needs to lie on.

There are a variety of EEG recording techniques, of which the polygram is probably the most standard. Another recording technique is spectral analysis. This method reproduces the range of amplitudes in the whole spectrum of wave activity over time over specific areas of the cortex. There are other newer EEG methods, such as Salb's computerized 'diasonics' and a machine called 'Mind Mirror', but the majority of published research tend not to use these tools. The reasons behind this phenomenon of limited use of EEG recording techniques are not clear. Certainly it appears there is a gap in the integration of tools used for research.

Other non-invasive techniques gather psychophysiological data on EMG, temperature, heart rate, and respiration rate. These sources of data are often incorporated in EEG studies. Technology for gathering these kinds of data has evolved impressively. Not only can this data be gathered by portable machines, but by remote and wireless ones which are capable of being worn trouble free by a newborn continuously for up to 8 days! Perhaps EEG technology will follow suit.

B. Kinds of EEG Research

From recent research literature there seems to be primarily 3 applications of these non-
invasive (and primarily EEG) methodologies for investigating human mental states. One application is to diagnose pathology. In this kind of research EEG is used in either of two ways. One way is to clarify and understand pathological neurological processes as they occur. Another way is to assist in the diagnosis itself. A few examples of the wide area of pathologies investigated include: a) mental disorders that are considered primarily psychological (i.e. not innate) such as stuttering, gambling, borderline character disorder, and anxiety; b) mental disorders often mixed with prior biological conditions such as schizophrenia, autism, depression, dyslexia, developmental delay, and psychogeriatric disorders; and c) medical pathologies (i.e. those that are generally understood as due to biological pathology) such as seizure disorders, Korsakoff's syndrome, and MBD.

A second application of these technologies is the study of mental states that result from pharmacological or other 'hard' interventions. In this type of research scientists have been able to gain insight into both the neurological processing associated with a pathology and the action of an intervention itself. Examples of a few recent studies include drug studies such as diazepam, imipramine, and cocaine. Other studies of this type include the effects of ECT, medication and epilepsy, and medication and sleep changes.

A third major area of EEG research is the study of the neurological correlates of mental processing while subjects are engaged in a task or activity. Recent studies have focused on attentional processes, cognition, personality, emotionality, excitatory states, hemisphericity, non-ordinary states of consciousness, meditation, hypnosis, breathing techniques, and psychotherapy. This third area of research could be of special interest to training and practice in psychotherapy. The remainder of this paper will focus on recent publications which either construct theories about neurological processing that may apply to psychotherapy, or that imply how to document or actually document psychophysiological changes that can be correlated with psychotherapeutic interventions.

II. Theories of Interest to Psychotherapy

A. Galin

Galin is one early and seminal theorist who postulated a relationship between the specialization of each hemisphere and the phenomenon of conscious and unconscious levels of mind. He used studies of commissurotomy patients to support the following ideas:

1. In normals each hemisphere is specialized for a different cognitive style. In right handed subjects, during speech and writing tasks the left hemisphere is active (showing high voltage, fast wave activity on an EEG) and the right hemisphere is on 'idle' (showing slower wave, alpha activity). The reverse is true during tasks involving holistic, gestalt, and spatial processing. Thus "...The two cerebral hemispheres in humans are specialized for different functions...because of their specialization they are different, not duplicate minds..." (P.572)

2. Galin notes that commissurotomy patients have retrieval problems that result in disconnected behavior. Since left brain processing resembles what is labeled as secondary thought processing in psychoanalytic theory, and since right brain processing resembles what is labeled as primary thought processing, the disconnected behavior of split brain patients seems to parallel the psychoanalytically postulated differentiation between secondary and primary thought processing. Further support for this parallel comes from studies which show that in split brain patients eventually left hemisphere activity becomes dominant. This is similar to how secondary thought processing becomes dominant in normals.

From these ideas Galin formulates that: "...there seems to be a clear parallel between the functioning of the isolated right hemisphere and the mental processes that are repressed, unconscious, and unable to directly control behavior." (P.574)
The causes for the dissociation between hemispheres in split brain patients is obvious. But how does the dissociation between conscious and unconscious in normals occur? Galin offers two processes that may permit such a functional dissociation. One process is innate, and that is that both sides of the brain may not be equally active at the same time. In normal waking conditions "...Such a relation of reciprocal inhibition of cognitive systems may be bases on left/right reciprocal inhibition so characteristic of the sensorimotor systems around which the whole brain is built." (P. 575)

This innate process of reciprocal inhibition is "harnessed" for adaptive purposes when the normal individual experiences cognitive dissonance. "In a child whose mother verbally says: "I'm doing this because I love you", while facially expressing: "I hate you and will destroy you" (P. 576), the two hemispheres will process the simultaneous input as if separate. Moreover, each hemisphere will ignore what disagrees with it's own formulations. Perhaps because neuronal connections between hemispheres are weaker than connections within hemispheres; or perhaps out of the need for survival a process of operant conditioning emerges and one hemisphere becomes dominant. Galin postulates that: "In normal intact people mental events in the right hemisphere can be disconnected functionally (by inhibition across the corpus callosum and other cerebral commissures) and can continue a life of their own. This hypothesis suggests a neurological mechanism for at least some instances of repression and an anatomical locus for the unconscious mental contents." (P. 575)

Galin suggests further research to explore this idea if separate minds of separate hemispheres. One suggestion is to document the expression of right hemispheric processes in modes not pre-empted by left hemisphere somatic expression. This includes a statistical study of the sidedness of conversion disorder symptoms. In fact a later followup study on this area confirmed Ferenzi's assertion that the symptoms were predominantly left sided. (Perhaps conversion disorders are an example of how psychological illness can reflect an attempt to speak from one's "right" mind!)

Galin also suggests that asymmetry in ANS activity may indicate asymmetric hemispheric activity. Changes in L/R skin temperature and skin conductance during mental processing might signal cerebral asymmetry. Also, changes in blood pressure vs. changes in heart rate could indicate asymmetrical processing as it occurs on subcortical as well as cortical levels.

Galin's ideas seem well substantiated and retrospectively appear to be precursors of ideas of more recent researchers/theorists. Three of his ideas seem to reappear often: 1) hemisphericity and reciprocal inhibition, 2) the involvement of the limbic system and other 'deeper' structures in "unconscious" processing, and 3) the involvement of the sensorimotor cortex processes with the development of self consciousness.

Yet Galin's ideas have one drawback. They are primarily academic. How a psychotherapist might make use of hemisphericity, autonomic variables, and motor experience to generate hypotheses and interventions is left over to imagination.

B. Gazzaniga

Gazzaniga's ideas and research on hemisphericity first appeared in the 1970's and were even a part of Galin's formulations (especially the notion of inhibition of neuronal transmission across the corpus callosum). More recently Gazzaniga seems to place less emphasis on hemispheric dissonance as leading to the phenomenon of repression. In this recent update Gazzaniga adds that the left dominant brain functions as an interpreter and constructor of a theory of self consciousness. He bases this idea on his work with a few unusual split brain patients. His research suggests that information can exist in the brain and can even be placed there without the language system's awareness. The same information can also be expressed through movement and still be unavailable to the left brain's language system. Gazzaniga theorizes that: "...the brain is organized in such a way that
information is stored in modules. These modules can compute, remember, feel emotion, and act. And they exist in such a way that they need not be in touch with the natural language and thinking systems underlying private conscious experience...what we hold as conscious experiences are, to a large extent, the verbally tagged memories associated with interpretations we have given to our behaviour." (P. 36) [In other words, the left brain]"...invents a stimulus to explain it's response...[thus...] In the process of making sense of diverse human actions, we develop "beliefs" about the nature of self, which become more multidimensional the more diverse mental modules are in behaviour."(P. 38) Gazzaniga believes that this innate process of constructing beliefs about ourselves (and the worlds we have constructed is evolutionarily adaptive: "The brain may be so organized in order to allow for the constant testing and retesting of our beliefs. If the brain were a monolithic system with all modules in complete internal communication our beliefs would never change...the incessant dual between thinking and behavior emerges as a very special feature to our species." (P. 38)

Some might argue against Gazzaniga's assertion that the left brain interpreter function is species adaptive. After all, aren't many psychopathologies evidence of the interpreter's failure to accept new stimuli that contradict it's theories about self and the world? And if Gazzaniga's assertion were true wouldn't the job of psychotherapist be simple? Never the less, Gazzaniga's recent findings and interpretations are framed in a language that may be useful to psychotherapists. Perhaps psychotherapy could involve: 1) assessing an individual's belief structure, 2) developing interventions that make new stimuli 'safe', and 3) bringing into awareness information that is stored out of the language system's awareness.

Theoretically from an EEG point of view, Galin and Gazzaniga might differ about what happens neurologically during psychotherapy. Galin's theory implies that EEG and ANS asymmetry would be clues of dissociative activity during therapy. Also implied is that this asymmetry might balance out over the course of treatment. Gazzaniga's ideas imply that while assymetry might shift during the processing of new material, assymetric activity might return upon integration, since the interpreter function would persist.

C. Jaynes

Jaynes is a third hemispheric researcher and theorist. Some of his work resembles Gazzaniga's, but it broadens the concept of the interpreter function and identifies a possible right brain site of neurological activity during psycho(patho)logical processing, especially the phenomenon of hallucination. Jaynes's theory is also more inclusive of other disciplines, including anthropology, history, and art. His theory is based on: 1) a definition of what consciousness is and what it is not; and 2) a hypothesis about the neurological correlates of those properties which he defines as consciousness. For Jaynes consciousness is like: "...a self illuminated flashlight that searches around for light in a dark room. Such a flashlight would come to the conclusion that the room was brilliantly lit, when in fact, it was mostly the opposite. ...So too with consciousness, we have the illusion that all is mentality..." (P. 129)

For Jaynes: "The subjective conscious mind is like an analog of the real world. It is built up with a vocabulary or lexical field whose terms are all metaphors of analogs of behaviour in the physical world. It's reality is the same order as mathematics. It allows us to short-cut behavioural processes and arrive at more adequate decisions. Like mathematics it is an operator rather than a thing or repository. And it is intimately bound with volition and decision." (P. 132)

This subjective consciousness has three important properties. First, as a result of language it features what Jaynes calls: "mindspace". "...it is the space which you are preoperatively introspecting at this moment... That is, mind space is not real space. It is a metaphor linking spatial experience with mental activity." (P. 132)

A second property of subjective consciousness Jaynes defines is the creation
of the "analog I" that does the seeing in mind-space. That is, if one can imagine oneself doing something; it is the analog I that would be doing the something. Jaynes defines a third property of consciousness as narratization. "Consciousness is constantly fitting things into a story, putting a before and after around every event." (P. 133) This last property strongly resembles Gazzaniga's 'interpreter' function.

In addition to defining these properties of consciousness, Jaynes rejects many traditional scientific assumptions about consciousness. One of these is that learning is a major element of consciousness. He cites human research studies that: 1) Learning not only goes on without consciousness but can be interrupted by it; 2) Consciousness is not attention. We don't have to be attentive to be conscious. Moreover, from learning studies, as learning increases, attention decreases; and 3) Reasoning can be done without consciousness. In fact Jaynes points out that some of sciences best inferences have been made spontaneously: "...in bed, in the bath, or on the bus." (P. 131). Like speaking, reasoning is a process that doesn't require conscious control over every item.

Another assumption that Jaynes rejects is that the mind and body evolved together. Jaynes points out that animal studies show that animals can learn (i.e. have mentality), but animals do not have anything like what we experience as subjective consciousness. To Jaynes, subjective consciousness is not the ability to have perception or to process perception, because these functions can be done without subjective consciousness. If one believes that those processes are innately conscious, then all living things, even single cells must have consciousness. Similarly, and going in the other direction of the evolutionary continuum, Jaynes rejects the idea of the human experience of consciousness as an emergent. For Jaynes the idea that some qualitatively different experience of consciousness emerged in the species when the brain reached a critical mass, tells us nothing about specific neurological processes of consciousness. (p. 128 & 129)

Given these parameters of what consciousness is and what it is not Jaynes makes a bold proposition: In the recent past human beings could have existed who do everything we do, but without self consciousness. In fact, Jaynes suggests that evolutionarily speaking, self consciousness came after language developed. Jaynes also believes that this development of consciousness is culturally and historically a recent event, perhaps no more than three thousand years old. Jaynes (who is a psychologist and biologist) suspects that although the human brain has been the same for some tens of thousands of years, what is different is how we use the brain now. (p. 132-139).

Some neurological support for Jaynes theory has been given by Ojemann, who offers research that shows the relative recency of the dominance of the language cortex in humans. He also submits that self conscious experience is dependent on the left brain language cortex and it's neurological links with the thalamo cortical activating system. However, Ojemann points out that this design is considerably older than three thousand years. (P. 158-168)

Jaynes suggests that prior to the sense of "I" as a self conscious experience, human beings were what he calls "bicameral". For Jaynes this means that bicameral humans did not employ the left temporal posterior cortex as we do today. Even though the 'hardware' (the brain) was in place then as it is now, bicameral humans relied on the right temporal cortex for interpretations and decisions which guide individual and collective behavior. Since the right hemisphere is more spatially oriented than the left, and since it also lacks the sequencing power of the left, Jaynes believes that bicameral humans received their guidance in the form of hallucinations. He speculates that as human populations grew in size and social systems became more complex this method of guidance through divine and probably auditory admonitions proved unreliable and bicameral societies fell apart. As a result the sense of self as an individual consciousness, or god as within, began to develop. (P. 132-139).
Jaynes believes that if his theory were true, then perhaps all of us are not far from being bicameral. He suggests that perhaps some aspects of psychopathology — notably hallucination — represent outmoded attempts to generate beliefs that give guidance. To support this he cites recent research on schizophrenia that suggests that the phenomenon of hallucination correlates with either an overactivity of the right hemisphere or left hemisphere deficits. (P. 171)

Jaynes's theory is impressive and intriguing. Yet, what does it offer to further add to the practice and understanding of what happens in psychotherapy? Jaynes's ideas about our present 'usage' of the left temporal parietal cortex and the possibly outmoded usage of the right temporal parietal cortex for interpretation and guidance seems to correlate with Galin's ideas about the dissociation between the hemispheres. Jaynes's ideas also offer a species historical developmental explanation about how the separation may have come about. Jaynes's theory also resembles Gazzaniga's ideas about how the left hemisphere language cortex is tied to the 'interpreter' function. Yet Jaynes's assertion that the right hemisphere could have and at times does give guidance provides an explanation missing from Gazzaniga's theory. That is, the theory of bicamerality explains why so called primary process thinking persists and penetrates the so called rational behavior governed by secondary thought processes. Jaynes's theory also explains why, however reasonable we try to be about our beliefs, about ourselves and our world, we seem to tenaciously hold on to irrational beliefs.

Perhaps effective psychotherapy "unconsciously" has guessed, like Jaynes, that we are more bicameral than we are aware of. Perhaps non-'talk oriented' methods of engaging the client work because the right hemisphere is more form and less word oriented than the left. Also, focusing on significant pre-operational periods of childhood (when available to be attended to) may be useful because during those periods right hemisphere processes dominated. (Perhaps it is true that those difficult to change beliefs about ourselves developed during this more bicameral like stage of development.) Finally, Jaynes's theory might support the possibility of increased amplitude fast wave activity over the right temporal parietal cortex while the old (or is it developmentally young?) interpreter within the client changes his/her mind. Like Galin and Gazzaniga such shifts could be useful indicators of effectiveness in psychotherapy.

III. Neurological Theories and Applications by Those Interested in Psychotherapy

The 'hemispherist' investigators thus far presented offer a number of ideas which imply what might be occurring on the neurological level during psychotherapy. The most consistent idea is that shifts in symmetry of cortical and subcortical activity may be associated with psychotherapy during treatment.

In recent literature there are only a few who investigate how changes in cortical and subcortical activity can help understand and generate treatment. In reporting on data with his own patients Glucksman tends to rely only on measures of autonomic activity (GSR, HR) rather than cortical measures. Yet his rationales are worth noting. One, is that these measures can indicate the emergence of unconscious conflicts. Another rationale is that such measures can help track patterns of somatic symptoms with psychological symptoms. Finally, physiological measures can document ongoing patient-therapist interaction.

Budzynski is one researcher and psychotherapist who has been developing approaches that incorporate studies of brain activity. He began his work in the late 1960's when there was enormous interest in altered states of consciousness. Budzynski's investigation of these states includes a wide range of phenomenon which led him to sleep research and brain lateralization studies.

From sleep research Budzynski focused on what he calls "twilight sleep". Essentially this is stage 1 sleep (which is represented by the presence of theta-4 to 7 Hz-activity in an EEG recording). Subjectively twilight sleep is the short lived hallucinations and
dream like experience that precedes deeper sleep, when sensory input is screened out. Twilight sleep also precedes the waking state which coincides with the presence of what Gazzaniga has called the 'interpreter' function. Citing Russian and American studies of learning during sleep, Budzynski concludes that: "...a common denominator among successful sleep learning studies is that superficial sleep (stage 1 and 2 sleep) is the psychophysiological background for maximum receptivity." (p. 433) From this Budzynski deduces that one way to work with patients who have severe self esteem problems or who are depressed would be to impart positive suggestions to them while they were in this mental state of maximum receptivity. Thus, state of consciousness became one feature of Budzynski's psychotherapy technique.

Another feature of his technique is that it incorporates a brain lateralization model. Budzynski bases his thinking in this area on three elements already researched by others. These are: 1) studies of the language abilities of the right hemisphere; 2) Galin and Gazzaniga's theories on hemisphericity; and 3) studies of hemispheric arousal levels.

Citing research on language comprehension of the right hemisphere, Budzynski notes that the right hemisphere: 1) processes voice intonation and emotional levels of speech; 2) needs redundancy, concreteness, common words, and direct and positive statements to aid absorption; 3) improves comprehension when sentences are given at 1/3 the normal rate of speaking and with frequent pauses, and 4) has the syntactical ability of a six year old. From this Budzynski concludes that: "If we wished to communicate verbally with the right brain, we would endeavor to use simple, concrete, common words spoken slowly, with a good deal of voice intonation, and repeated over and over again." (P. 439)

Budzynski's rationale for choosing to communicate with the right (non-dominant) hemisphere comes primarily from Galin's ideas about hemispheric conflict. That is, conflicting conclusions made independently by each hemisphere results in the inhibition of one hemisphere's conclusion, but not the influence of that conclusion. For Budzynski, psychotherapy then must also involve the accessing of that conclusion (what he calls the 'negative script') and changing it. (P. 448) However, in order to access and change that 'repressed' conclusion, part of the procedure, according to Budzynski must involve either reducing or eliminating the critical screening mode (i.e. Gazzaniga's 'interpreter') of the left (dominant hemisphere).

In order to accomplish this 'by-passing', Budzynski utilizes data from EEG studies that suggest that the right hemisphere remains functioning at levels of cortical arousal that are too low to support the critical screening function of the left hemisphere. Similarly, he notes other research that suggests that during extended periods of high level cortical arousal the critical screening function declines, leading to increased susceptibility to outside influences. (P. 439) Thus, he concludes, the normal critical screening function can be by-passed in either of two ways. One way is by arousal that taxes the left hemisphere's attempts to create order and meaning. Examples of this technique could be M. Erikson's 'confusion' techniques, or embedded commands. Similarly the left hemisphere is by-passed and the right hemisphere becomes dominant during highly charged emotional states or during physically taxing activities such as dance, sports, and some religious practices. Another way to by-pass the critical screening function is to lower cortical arousal levels as might occur during quieting relaxation methods, rhythmic or repetitive activities (such as chanting or drawing) or in a monotonous restricted environmental stimulation (as in Morita therapy). Budzynski notes other researchers have suggested that this shift from or by-passing of the critical screenner function is correlated with increases in left/right alpha ratio.

With these elements from theory and research Budzynski developed his form of biofeedback therapy which he called "twilight learning." The biofeedback to the client comes in the form of tape recorded positive suggestions (e.g. "I am good even when I say 'no'.") that automatically play when the left hemisphere EEG shows theta and the absence of alpha and
beta rhythms. Since these two rhythms are associated with wakefulness (and hence, critical screening), the tape stops playing when these rhythms appear. To prevent slower frequencies from emerging (i.e., deep sleep and hence the gating out of sensory input) the tape player volume would increase as these frequencies occur. Budzynski found that theta needed to be present for at least 25% of the one hour session in order for treatment to be effective. The length of this treatment ranged from five to twenty sessions.

In light of the questions guiding this paper, Budzynski's work is impressive. He appears to be one of the earliest researchers to explore the obvious and neglected territory where modern neurology and psychotherapy overlap. Twilight learning could be considered mechanistic, yet of non-chemical, non-surgical, 'soft' interventions it appears to be measurably effective. How many approaches to psychotherapy can objectively define the parameters of success during and after treatment?

However, one important drawback to Budzynski's twilight learning technique is that there are not many published reports/studies in recent years. From the most recent publication Budzynski appears to have become more inclusive in current therapies. (P. 457) He also is developing new biofeedback applications. One new area he is working on is the psychophysiology of cancer. But for now we can only await news of this work.

Budzynski's work is not only impressive because it incorporates ideas of hemisphericity. He is one of the few researchers and clinicians who incorporates information from the vast and growing field of sleep research. Along these lines of incorporating states of cortical arousal is Broughton41, who has been investigating the relationship between states of consciousness and sleep/wake cycles. Already well known is that the highly subjective experience of consciousness undergoes qualitative changes throughout the day and night according to innate, lawful and objectifiable rhythms. Broughton cites new research that suggests that dreaming, problem solving, and other mental activities such as scanning/monitoring of external stimuli are not limited (as had been thought) to the domains of any one state (waking, REM, NREM). Rather, many of these functions are ongoing, although highly personalized and qualitatively different during each state of consciousness.

Broughton relates the above idea that some mental processes are continuous during waking and sleeping states to ultradian rhythms (what is subjectively experienced as shifts in degree of wakefulness) and circadian rhythms. Although somewhat guardedly, he proposes that there is a relationship between Kleitman 900 minute Basic Rest Activity Cycles (BRAC) and cyclic increases in right hemisphere activity.

One inference which Broughton makes from this proposal is that perhaps many instances of what might be major psychopathology in an 'awake' person may reflect disturbances in circadian sleep/wake cycles. He cites nightmares, automatic behaviors, delirium, and double consciousness as examples of what clinicians are usually taught to recognize as psychopathology, but may actually represent sleep/wake disorders.

Another implication from Broughton's ideas about a relationship between innate body rhythms and consciousness is that the limbic system and the brain stem may be involved in psychopathology and its' treatment. Galin and others have already pointed out that these structures may be related to unconscious processes. Yet a more intriguing implication is that there may not only be opportune times for psychotherapy (i.e., time when non-dominant hemisphere activity increases), there may also be opportune lengths of time for treatment sessions. Would a 90 minute session prove more effective than a 50 minute session, regardless of technique?

Rossi would probably give an enthusiastic though qualified 'yes' to the above question42. Rossi is a colleague of M. Erickson, and a researcher in the field of hypnotherapy. He reports that Erickson himself had explained that he had trained himself to notice and utilize natural periods of quietness which became known as 'Common
Everyday Trance' (CET). It was during these periods that a patient was most receptive for experiencing trance. This CET is readily discernable to a trained eye and can be indicated by numerous affective, cognitive, respiratory, motor, and social behaviors. (P. 100) From experience, Erickson also learned that this state seemed to occur somewhere within 90-120 minute periods, so he would vary the length of the treatment session so as to include and encourage this period.

As Rossi continued to study Erickson's work he began to relate the physiological indicators of the CET state with the physiological changes which had been documented on BRAC rhythms. That is, during CET the shifts towards parasympathetic ANS activity and towards non-dominant hemisphere activity were equivalent to the fluctuations in ANS and hemispheric activity during ultradian rhythms. Rossi concluded that Erickson was correct in guessing that the idea of consciousness as having continuity is an illusion and that the phenomenology of consciousness was dependent on physiological state. For Rossi, if this dependency were true, then disturbances in ultradian rhythms could result in disturbances in consciousness. He regards psychosomatic disturbances as most likely resultant of such disturbances. Thus, for Rossi, 'healing' would involve the removal of barriers to the normalization of (at least) this biological clock. Perhaps in order to heal psychologically we may not only need to think and know better (i.e. gain insight), we may also need to feel physically better.

Rossi's research led him to investigate the synchronization and desynchronization of ultradian rhythms. One interesting area of research which he cites is the relationship between cycles of nasal dominance and cycles of ANS and cerebral hemisphere dominance. He notes Wernzt's research which documents a direct relationship between nasal dominance, ultradian rhythms, and hemisphere dominance. (P. 119) Wenzt had also found that forced uni-nostril breathing through the non-dominant nostril induced a shift in dominance to the contralateral hemisphere. Perhaps such practices could be useful in undoing psychosomatic disturbances. The benefits of alternate nostril breathing have been well known and commented on by yogis for at least 2500 years.

From her research Wentz makes an interesting proposal and one that resembles Ojemann's reference to limbic structures that may underwrite the experience of consciousness:

"...Thus the whole body goes through Rest/Activity or parasympathetic/sympathetic oscillation while simultaneously going through the 'Left Body-Right Brain/Right Body-Left Brain" shift. This then produces ultradian rhythms at all levels of organization from pupil size to higher cortical functions and behavior...It is important to note that this represents an extensive integration of autonomic and cerebral cortical activity, a relationship not previously defined or studied. We propose that as the nasal cycle probably is regulated via a centrally controlled mechanism, possibly the hypothalamus, altering the sympathetic/parasympathetic balance, this occurs throughout the body including the brain and is the mechanism by which vasomotor tone regulates the control of blood flow through the cerebral vessels thereby altering cerebral hemisphere activity."43

Rossi's hypotheses about neurological processes that may be involved in psychotherapy and psychopathology again add a 'depth' idea to the location of unconscious processes. During psychotherapy the therapist may not only track and engage cycles of cortical activity, the therapist may also track and engage cycles of activity in the limbic system. Perhaps treatment techniques should acknowledge this. That is, in addition to selectively passing the range of left brain linguistic activity and communicating with the child-like and concrete and wholistic activity of the right brain, the therapist may also need to interact and communicate with an organization of consciousness which may be prior to self consciousness and prior to words.

Fischer's ideas of consciousness44 may be helpful in clarifying what kind of neurological input therapists could give and how that input may be considered therapeutic. To Fischer, "...Consciousness is a domain of
internalization, an insight into oneself as a moving experience."
(P. 3) To support this idea he cites EEG data and pharmacological evidence that suggest a direct relationship between mental activities and neuromuscular behaviors. For Fischer this interdependence is so strong that interference or inhibition of neurological pathways for sensorimotor closure results in distortions in mental activity. Fischer cites the hyperaroused state of the cortex during drug induced states or during REM as examples of such distortions. In these states sensory perception and motor activity are inhibited or overridden and this results in an imbalance of sensorimotor closure which is reflected in mental constructions that are (concretely speaking) not sensible.

Fischer's work is more academic than practice based. That is, he doesn't offer therapeutic techniques to engage and restore sensorimotor closure. Perhaps those psychotherapies which reflect the old saying: "Actions speak louder than words" may reach this deeper neurological level. Examples of such therapies might be classical and operant conditioning techniques, and the more current and blossoming field of therapies that utilize bodily experience (e.g. dance, movement, and other expressive therapies; hatha and other 'limbs' of yoga; bioenergetics, feldenkrais, hakomi, gestalt and other techniques that utilize kinesthetic awareness).

IV. Studies Indicating Neurological Activity during Activities Relating to Psychotherapy

Thus far there appear to be two related neurological levels of activity that may correlate with the psychological experience during psychotherapy. One idea is that healing in psychotherapy may correlate with an organized shifting of cortical activity away from the dominant hemisphere (and perhaps more specifically the areas involved in language production). Once this shift has occurred, new beliefs and experiences that may generate change on the psychological level (i.e. self conscious level) can be offered and accepted.

Another idea is that treatment and change on the psychological level might be associated with changes on subcortical levels, such as the limbic system and the neuronal pathways and substructures associated with the regulation of biological cycles. Thus, some psychotherapeutic techniques may work by engaging and entraining physiological behaviors.

These ideas are intriguing and offer new territory for researching and developing psychological treatment techniques. Yet there are only a few recent publications which make use of EEG or other non-invasive techniques to explore and document neurological activity associated with behaviors or techniques considered to be therapeutic.

Meditation has been regarded as therapeutic on many levels, including the psychological, and studies on the effects of meditation abound. In a recent review of the literature Delmonte\textsuperscript{45} summarized findings on electrocortical activity and related phenomenon associated with meditation. One finding is that changes in hemisphericity may be a function of the meditation technique and the level of skill of the meditator. That is, in the beginning stages of meditation increases in left hemisphere slow wave activity may give way to increasing slow wave activity in the right hemisphere. However, in deep meditation both hemispheres show increases in slow wave activity, implying an inhibition of both right and left hemisphere activity. Delmonte noted that the majority of studies indicated an overall pattern of: 1) increases of alpha in the frontal and central regions, 2) a gradual slowing of alpha, and 3) a forward spread of alpha activity, beta spindle, and intermittent theta. Delmonte concludes that meditation is not a unique state, since these cortical changes are similar to those found during other hypnotic and relaxation techniques.

These findings on the neurological activity during meditation seem to support at least one view of what might be happening neurologically during psychotherapy. That is, during effective treatment a state of consciousness occurs (that could be called mindfulness, relaxation, hypnosis, or meditation) which may be correlated with
increased low amplitude, slow wave activity in the left hemisphere. This would support the idea that psychotherapy may involve a shift away from the language areas of the cortex. Delmonte's review does not include measures of ANS activity, yet the overall inhibition of the cortex, especially the frontal region could imply that such techniques may effect subcortical (possibly thalamic) levels as well.

EEG findings on the effects of Primal Therapy tend to support both views about the possible neurological activity during psychotherapy. In an early study, Hoffman had hypothesized that successful treatment should correlate with increases in Right/Left mean amplitude ratio and Right/Left variance ratio (variance of amplitudes ranged within 1.5-30 Hz), since prior research had shown ratios were lower than 1.0 in neurotics and 1.0 in normals. On the short term this hypothesis was confirmed. Interestingly, Hoffman also noted that after sessions involving intense emotional reaction patients showed a substantial and statistically significant increase in the variance of amplitudes in the right hemisphere, while this variance remained unchanged in the left hemisphere. For Hoffman this data also suggested that the right hemisphere is more involved than the left in processing emotional activity.

In a subsequent study, Hoffman explored the effects of long term Primal Therapy on patients' EEG. This study revealed a tendency to develop R/L mean amplitude and variance ratios of 1.0 or better (over time). Hoffman also showed that patients in the advanced stages of therapy had lower posterior amplitudes and higher anterior alpha amplitudes than untreated normals or neurotics. He noted that this 'normalization' process involved the stabilization of right hemisphere alpha while left hemisphere alpha amplitude tended to decrease. From this he made two conclusions. First, Hoffman believes that during long term treatment the increases in R/L ratios suggest increases in right brain activity indicating increased emotional processing. Secondly, over long term treatment the left hemisphere tends to become more active than the right. Hoffman's research suggests a parallel with the research on meditation. Both beginner meditators and primal patients show increases in right hemisphere activity. Both advanced meditators and advanced primal patients showed a normalization of hemisphere activity. Finally, both advanced meditators and long term primal patients showed a general forward spread of alpha.

But why the parallel between Primal Therapy research which is based on data over a time span of many sessions and meditation research which is based on data during individual meditation sessions? Ahern's study on lateralization during emotional activity may clarify this problem (a little). In this study subjects were not given treatment, rather they were given sample questions designed to stimulate and access emotional activity. For example, a question might be: "make up a sentence using the words 'extremely discouraged.'" (p. 747) Each subject's EEG was recorded for a 20 second period during which the subject was instructed "to think about" their response. By analysing changes in alpha during these periods Ahern found that the left frontal zone seemed most involved in processing positive emotions, and the right frontal zone most involved in processing negative emotions. Ahern also noted that the right parietal zone appeared to be activated regardless of emotional valence.

Putting together the studies on emotional processing, Primal Therapy, and meditation, it can be inferred that: 1) effective psychotherapeutic treatment correlates with shifts in cortical activity in both the long and short term, 2) treatment makes it safe to process negative emotions, and 3) in long term treatment patients subjective experience of positive feelings and emotions may correlate with decreases in alpha from at least the left frontal zone.

Another interesting dimension to understanding what may be happening neurologically during psychotherapy is to include data on the simultaneous behaviors of the therapist. Allred's research used videotaping, charting of heart rate and respiration rate and a computerized tabulation of verbal and non-verbal behaviors of both client and therapist to examine and improve therapy and supervision. Although this study
does not include EEG data, it does present a research method that uses psychophysiology. One interesting outcome is that there appears to be a parallel and non-verbal orienting process between both client and therapist which occurs within the first few minutes of the session, and which may even determine the session outcome. Gestures, postures, heart rates, and respiration rates increased in activity preceding a period in which the client and therapist became verbally incongruent. Yet during non-verbal incongruence both were verbally congruent. (Allred uses an Adlerian model of psychotherapy.) This finding may indicate that there are mechanisms that are prior to the mechanisms of conscious words that are at work in both the client and therapist. Perhaps psychotherapy is more than a dialogue of words. Perhaps it is a conversation between nervous systems.

Research on the effects of therapist presence during biofeedback training seems to confirm this idea. Borgeat's study indicated that the psychophysiological effects of the therapist's presence during headache relief training varied according to the individual therapist involved and not whether or not the therapist was present. So therapists 'do' something even when doing nothing!

What behaviors and mechanisms are involved in both the client and therapist needs further investigation. Perhaps some of the methodology and findings from recent research on infant-caregiver interaction will be incorporated as part of the investigation of the neurological correlates of psychotherapy. One study investigated how infant-caregiver interaction led to the biorythm consolidation and entrainment in both the infant and caregiver. Perhaps some mechanism of consolidation is an element in client-therapist interaction.

V. Summary

Research in ongoing human mental states is in an early stage of development. Yet however young this field may be, it has already produced enormous quantities of data and technological progress. Integration of findings from just one area of this field, such as the area of mental processing during activities could be useful in assessing psychopathology and in training and practice in psychotherapy.

From the material reviewed in this paper a few ideas stand out as of interest to the field of psychotherapy. One is that effective psychotherapy may include shifts in state of consciousness which may be characterized by shifts in cortical activity. More specifically, there may be shifts in levels of lateral activity during emotional processing. In right handed people decreases in left hemisphere activity may signal a receptivity for psychological change. Also the ability to sustain a general decrease in frontal activity (while awake) might be characteristic of psychological health.

What therapists can do (if a therapist is used at all) to generate these shifts is only beginning to be explored. Tracking the client's process and encouraging a slower pace, using body posture, as well as timing, voice intonation, and the pacing and content of the therapists message may all be used to guide the therapeutic process. The presence of a therapist appears to be a significant factor in the process and new portable EEG and biotelemetry should permit objective and non-intrusive studies into what may indeed be a bipersonal process.

From a methodological standpoint, current EEG data processing techniques need to be evaluated for suitability with this kind of research. Standard Electrode placements seem adequate and key areas would probably be the anterior, temporal, parietal, and frontal zones. There temporal parietal areas may be of special interest during periods of emotional processing and insight. Autonomic data including both right and left sympathetic and parasympathetic activity appear as significant and should continue to be incorporated in future studies.

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