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The Neuroscience of Observing Consciousness & Mirror Neurons in Therapeutic Hypnosis[1]

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Neuroscience documents the activity of "mirror neurons" in the human brain as a mechanism whereby we experience empathy and recognize the intentions of others by observing their behavior and automatically matching their brain activity. This neural basis of empathy finds support in research on dysfunctions in the mirror systems of humans with autism and fMRI research on normal subjects designed to assess intentionality, emotions, and complex cognition. Such empathy research now appears to be consistent with the historical and research literature on hypnotic induction, rapport, and many of the classical phenomena of suggestion. A preliminary outline of how mirror neurons may function as a rapport zone mediating between observing consciousness, the gene expression/protein synthesis cycle, and brain plasticity in therapeutic hypnosis and psychosomatic medicine is proposed. Brain plasticity is generalized in the theory, research, and practice of utilizing mirror neurons as an explanatory framework in developing and training new skill sets for facilitating an activity-dependent approach to creative problem solving, mind-body healing, and rehabilitation with therapeutic hypnosis.

Key Words: Brain plasticity, creative, empathy, gene expression/protein synthesis, activity-dependent hypnotic induction, ideodynamic, implicit processing heuristics, mind-body, mirror neurons, psychosomatic, rapport zone, rehabilitation, segmentalized trance, skill sets.

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The Neuroscience of Observing Consciousness & Mirror Neurons in Therapeutic Hypnosis

The history of hypnosis is rich in accounts of the psychosocial phenomena of hypnosis when experienced during group demonstrations where people imitate and role-play each other's behavior (Edmonston, 1986; Tinterow, 1970). The actual mechanisms by which these psychosocial phenomena facilitate hypnotic induction and phenomena remain poorly understood, however. Neuroscience now documents the activity of "mirror neurons" in primates and humans that function as a neural mechanism for empathy whereby we understand others by observing their behavior and matching their patterns of brain activity (Siegel, 2006). This neural basis of empathy finds further support in research on dysfunctions in the mirror systems of humans with autism (Dapretto et al., 2005) and Asperger syndrome as well as fMRI research designed to assess emotional empathy with normals (Jeffries, 2005; Miller, 2005; Stamenov & Gallese, 2002). This paper proposes that neuroscience research on mirror neurons could provide a new empirical foundation for exploring the fundamental processes of therapeutic hypnosis and suggestion on all levels from the psychosocial to brain plasticity and molecular-genomics.

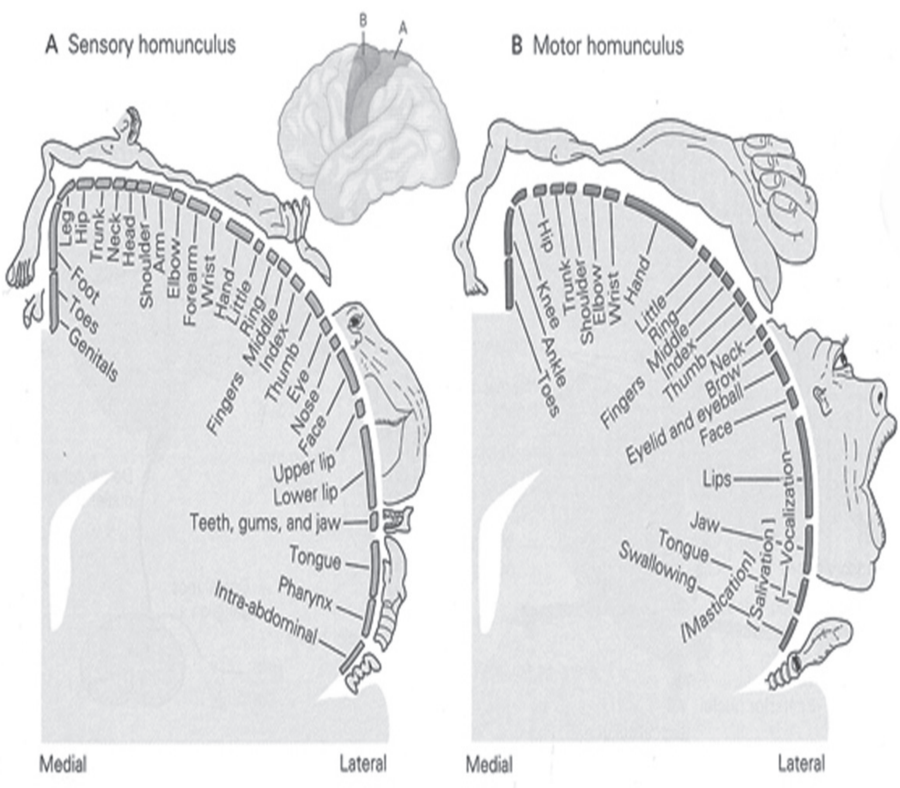
The Neuroscience of Mirror Neurons and Rapport Zones of Hypnosis

Initial research on the discovery of mirror neurons by Giacomo Rizzolatti and his research team at the University of Parma in Italy during the early 1990's is described by Miller (2005) as follows:

> "We didn't believe it," Rizzolatti says. The team's skepticism dissipated with repeated experiments, however. The finding was exciting, Rizzolatti says, because it fit with ideas that were coming together at the time in philosophy and cognitive science, such as the hypothesis that understanding the behavior of others involves translating actions we observe into the neural language of our own actions. The monkey mirror neurons seemed to do just that, providing a potential neural mechanism to support that proposal.
>
> Subsequently, researchers used functional magnetic resonance imaging (fMRI) and other techniques to investigate brain activity as people made—and observed others making—*hand movements and facial expressions*. These studies identified mirror-like activity in several regions of the human brain, including a region of frontal cortex homologous to F5.
>
> This human frontal region, known as *Broca's area, is also involved in speech production—a connection that snared the attention of researchers studying the evolution of language*. . . Rizzolatti and others have argued that mirror neurons could facilitate the imitation of skilled movements like t*he hand and mouth movements used for communication*. . .the mirror system in the frontal cortex is active as novices learn to play chords on a guitar by watching a professional guitarist. Similar learning by imitation is a key feature of language acquisition in infants and is widely considered *a prerequisite for language evolution* (p. 946, italics added).

The focused operation of mirror neurons in the hand and mouth movements used for communication which are a prerequisite for language evolution is consistent with the classical sensory-motor homunculus of the human brain illustrated in figure 1 (Penfield & Rasmussen, 1950). The apparently gross oversize of the hands and lip-tongue-facial anatomy, particularly evident in the motor cortex of figure 1, reflects the very large areas of the brain's sensory-motor cortex devoted to these two important areas in the evolution of language and communication in humans.

Figure 1: Penfield and Rasmussen's Sensory-Motor Human Homunculus
The Mind-Body Human Sensory-Motor Homunculus. The oversize hands and lip-tongue-facial anatomy reflect the unusually large areas of the brain that evolution has selected to map these two important areas of grasping and communication (Adapted from Penfield & Rasmussen, 1950). A. The sensory homunculus is postulated as being activated in a set of "rapport zones" via the ideosensory processes of therapeutic hypnosis. B. The motor homunculus is postulated as activated in a set of "rapport zones" during the ideomotor processes of therapeutic hypnosis. The premotor mirror neurons that are involved in empathy and understanding the intentions of others (Iacoboni et al., 2005) are now postulated as being activated in "rapport zones" generating gene expression and brain plasticity via the ideodynamic processes of mind-body healing during the activity-dependent approaches to therapeutic hypnosis (Rossi, 2002, 2004; Rossi & Cheek, 1988).



The rather startling images of figure 1 are explored here to conceptualize a neuroscience rational for the utilization of mirror neurons in the theory, research, and practice of the new skill sets utilizing hand mirroring and internal speech in the induction and application of therapeutic hypnosis described in a later section.

Rizzolatti and Arbib (1998) summarize the brain localization and activity of mirror neurons for understanding behavior, communication, and the psychosocial interaction between an observer and an actor as follows:

> *In monkeys, the rostral part of ventral premotor cortex (area F5) contains neurons that discharge,* both when the monkey grasps or manipulates objects and when it observes the experimenter making similar actions. These neurons (mirror neurons) appear to represent a system that matches observed events to similar, internally generated actions, and in this way forms a link between the observer and the actor. *Transcranial magnetic stimulation and positron emission tomography (PET) experiments suggest that a mirror system for gesture recognition also exists in humans and includes Broca's area.* We propose here that such an observation/execution matching system provides a necessary bridge from 'doing' to 'communicating', as the link between actor and observer becomes a link between the sender and the receiver of each message *(p. 188, italics added).*

This "observation/execution matching system" which provides a necessary bridge from 'doing' to 'communicating' as the link between actor and observer" appears to provide a neural mirroring system that could be an essential mechanism for the sensitive and highly focused empathy between therapist and subject in hypnosis. A more recent study (Fogassi, Ferrari, Gesierich, Rozzi, Chersi, & Rizzolatti, 2005) generalizes the function of mirror neurons in observation, behavior, cognition, and "mind reading" in a manner that may have important implications for therapeutic hypnosis as follows:

> I*nferior parietal lobule (IPL) neurons were studied when monkeys performed motor acts embedded in different actions and when they observed similar acts done by an experimenter. Most motor IPL neurons coding a specific act (e.g., grasping) showed markedly different activations when this act was part of different actions (e.g., for eating or for placing). Many motor IPL neurons also discharged during the observation of acts done by others. Most responded differentially when the same observed act was embedded in a specific action*. These neurons fired during the observation of an act, before the beginning of the subsequent acts specifying the action. Thus, these neurons not only code the observed motor act but also allow the observer to understand the agent's intentions (p. 622). . . Understanding "other minds" constitutes a special domain of cognition. *Brain imaging studies suggest that several areas might be involved in this function.* Given the complexity of the problem, it would be naïve to claim that the mechanism described in the present study is the sole mechanism underlying mind reading, yet the present data show a neural mechanism through which a basic aspect of understanding intention may be solved. Furthermore, they represent an example of how action and cognition are linked with one another and how

> the refinement of the motor organization may determine the emergence of complex cognitive functions *(p. 666, italics added).*

From the perspective of therapeutic hypnosis, the experience of empathy and understanding "other minds" would appear to be the essence of what has been called "rapport" and the "rapport zone" in the historical literature of hypnotic induction and the facilitation of the classical hypnotic phenomena. In a discussion of the early theories of Pavlov and Platonov, for example, Edmonston (1986) summarizes the neural mechanism of hypnotic induction via verbal suggestion as follows:

> *"The* rapport zone *produced in the sleeper [hypnotic subject] by verbal suggestions is a more or less confined center of concentrated excitation isolated from the remaining regions of the cortex" (Platonov, 1955/1959, p. 43). This then is the manner of hypnotic induction, internal inhibition produced through circumscribed excitation zones established by monotonous verbal patter. . . But the* rapport zones *serve more of a function than merely making induction possible. It is through these zones that the hypnotist maintains the capability of eliciting further hypnotic phenomena by additional verbal suggestions. . .If the process of hypnosis was conceived of as a process of increasing inhibition, interspersed with* zones of rapport*, then the subsequent elicitation of hypnotic phenomena was a process of disinhibition. As suggestion calling for some sort of alert action were offered, other area of the cortex became uninhibited to fulfill the task required (p. 315, italics added).*

Edmonston (1986) then goes on to describe the Creative Imagination Scale wherein the neural mechanisms of rapport zones are areas of disinhibition or heightened activity in the brain , and are used to account for the efficacy of verbal suggestion in facilitating classical hypnotic phenomena such as hand levitation, arm heaviness, finger anesthesia, sensory hallucinations, time distortion, age-regression, mind-body relaxation, etc (pp. 374-381). The concept of rapport zones provides insight into the mechanisms of state dependent memory and learning as well as dissociation during segmentalized trance (Rossi, 2002, pp. 356-357) originally described by Erickson (1985/2006) as follows:

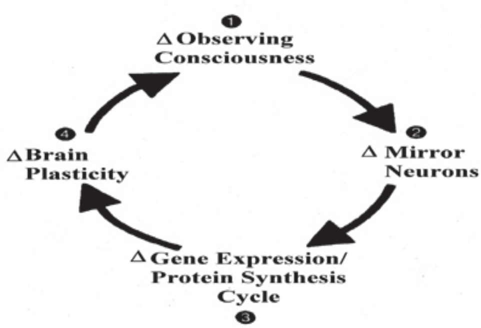
> Over and over again I have observed the readiness with which patients spontaneously develop the type of trance that best fits their needs. The dental patient can walk into a dental office and have a nice oral hypnosis—his legs are out of hypnosis, his hands are out of hypnosis, his body is out of hypnosis, but his mouth and jaws are in hypnosis. And you can have chills run up and down your spine, and when you are cold you can get goose bumps all over your body. But you can also limit those goose bumps to just one arm and just one hand. In hypnosis, you have the same opportunity of letting patients respond to the hypnotic situation by doing it locally. Therefore, when you work hypnotically with patients you do not necessarily try to get the same kind of trance that I use when I want to demonstrate all the varieties of hypnotic phenomena. You may not want the kind of trance wherein you do extensive psychotherapy. The point is that you try to use the kind of hypnosis which will allow your patient to achieve appropriate goals (p. 204).

We now propose that such heightened activity in the rapport zones (illustrated in the sensory-motor homunculus of figure 1) during the segmentalized trance is what neuroscientists today would describe as the activation of selective portions of the sensory-motor mirror neuron system in complex cognition and cultural transmission (Morrison, 2002). From our current perspective on mirror neurons 100 years after the pioneering research of Pavlov and 50 years after the work of Platonov, (1955/1959) on "the word as a physiological and therapeutic factor" it is tempting to hypothesize that activating "rapport zones" in hypnosis is what neuroscience now describes as turning on (activating) the gene expression/protein synthesis cycle and brain plasticity in the sensory-motor cortex and related brain areas by novel and enrichening psychosocial cues. The concepts of rapport zones, segmentalized trance, and state dependent memory and learning are related concepts that complement but do not replace the more global special state concept of hypnosis (Hilgard, 1977; Rossi, 2002, 2004, 2005). Further research relating mirror neurons to rapport zones may provide data for a neuroscience model of therapeutic hypnosis that could specify the relationships between the segmentalized and global special state concepts of therapeutic hypnosis as the modulation of activity on all levels from the molecular genomic, neural, and anatomical to psychological experience (Barabasz et al., 1999; Feldman, 2004; Nash, 2005).

Toward a Neuroscience Model of Therapeutic Hypnosis: Generalizing Rapport and Brain Plasticity in Psychosomatic Medicine

Research, by Buccino, Vogt, Ritzl, Fink, Zilles, Freund, & Rizzolatti (2004), documenting how the mirror neuron system is active when subjects imitate novel hand postures is reminiscent of the important role of the psychological experiences of novelty, enrichment, and exercise (mental and physical) in generating activity-dependent gene expression/protein synthesis cycle and brain plasticity in humans at all stages of life (Rossi, 2002, 2004). Figure 2 is a preliminary outline of a very general neuroscience model of how the mirror neuron system may operate in the creative loop of information transduction between observing consciousness, the gene expression/protein synthesis cycle, and brain plasticity (Rossi & Rossi, 2006).

Figure 2: The Ideodynamics of Psychobiological Information Transduction in Neuroscience. This 4-stage outline of how the mirror neuron system may operate in iterating/recursive causal loops between observing consciousness, the gene expression/protein synthesis cycle, and brain plasticity is consistent with current neuroscience models of memory and learning. The delta symbol (triangle) indicates that a specific change at any level leads to a functional change in the next (Updated from Rossi, 1996, 2002, 2004).



It has been proposed that current technology in DNA microarray technology and brain imaging may make it possible to relate each of these four levels of information transduction in figure 2 with a set of differential equations that link (1) changes in consciousness with (2) changes in mirror neurons, (3) the molecular-genomics, and (4) brain plasticity in therapeutic hypnosis (Rossi, 2005/2006). A neuroscience model of some aspects of this mind-body integration via computer simulations of fast and slow positive feedback loops on the cellular level has been documented in a recent paper by Brandman, Ferrell, Li, & Meyer (2005). Current research in the generalization and quantification of brain plasticity in many different areas is beginning to provide the empirical data for specifying the functional relationships and setting the parameters for evolving neuroscience models (Cohen, 2004) that could be applied to therapeutic hypnosis, rehabilitation, and psychosomatic medicine in general.

A new schematic model of this neuroscience causal loop diagram between observing consciousness, mirror neurons, the gene expression/protein synthesis cycle, and brain plasticity is presented in figure 2. While research on brain plasticity originally centered on synaptogenesis and neurogenesis in the hippocampus and cortex in memory and learning via LTP and LDP (Rossi, 2002, 2004), more recent research on mirror neurons is uncovering how brain plasticity is associated with a wide range of cognitive, emotional and psychosocial behaviors: the amygdala, insula, and superior temporal cortex are related to empathy and emotions (Carr, Iacoboni, Dubeau, Mazziotta, & Lenzi, 2003); the inferior parietal lobe with recognition of intentions (Fogassi, Ferrari, Gesierich, Rozzi, Chersi, & Rizzolatti, 2005); the ventral premotor cortex associated with the recognition of actions even when they are hidden from view (Umiltà, Kohler, Gallese, Fogassi, Fadiga, Keysers, & Rizzolatti, 2001); activity and movement (Stefan, Cohen, Duque, Mazzocchio, Celnik, Sawaki, Ungerleider, & Classen, 2005): speech (Iacoboni, Molnar-Szakacs, Gallese, Buccino, Mazziotta, & Rizzolatti, 2005); sexuality and social dominance (Burmeister, Jarvis, & Fernald, 2005); and the sense of the self (Zimmer, 2005).

A particularly instructive example of this generalization and quantification of brain plasticity related to appetite and energy metabolism in the hypothalamus is being made by defining its neural circuitry and responses to environmental cues. Kokoeva, Yin, & Flier (2005), for example, reported that appetite and feeding behavior can be modulated by quantifiable brain plasticity in the hypothalamus in adult mice with a neurotrophic factor that can induce long term weight loss. Likewise Burmeister, Jarvis, & Fernald (2005) summarized how psychosocial processes can modulate gene expression, brain plasticity, and sexuality "within minutes" in animal models as follows:

> *From primates to bees, social status regulates reproduction. In the cichlid fish Astatotilapia (Haplochromis) burtoni, subordinate males have reduced fertility and must become dominant to reproduce. This increase in sexual capacity is orchestrated by neurons in the preoptic area, which enlarge in response to dominance and increase expression of gonadotropin-releasing hormone 1 (GnRH1), a peptide critical for reproduction. Using a novel behavioral paradigm,* we show for the first time that subordinate males can become dominant within minutes of an opportunity to do so, displaying dramatic changes in body coloration and behavior. *We also found that social opportunity induced expression of the immediate-early gene egr-1 in the anterior preoptic area, peaking in regions with high densities of GnRH1 neurons, and not in brain regions that express the related peptides GnRH2 and GnRH3. This genomic response did not occur in*

> *stable subordinate or stable dominant males even though stable dominants, like ascending males, displayed dominant behaviors. Moreover,* egr-1 *in the optic tectum and the cerebellum was similarly induced in all experimental groups showing that* egr-1 *induction in the anterior preoptic area of ascending males was specific to this brain region.* Because egr-1 codes for a transcription factor important in neural plasticity, induction of egr-1 in the anterior preoptic area by social opportunity could be an early trigger in the molecular cascade that culminates in enhanced fertility and other long-term physiological changes associated with dominance *(p. 363, italics added).*

Bhattacharjee (2005) reports a comment on this study that has implications for therapeutic hypnosis and mind-body regulation in humans:

> Gregory Ball, a neuroscientist at Johns Hopkins University in Baltimore, MD, *says the study shows that social cues alone can have "powerful" effects on gene expression in the brain.* "It is quite reasonable to speculate that other species, including humans, who regularly encounter complex social situations. . . also exhibit such expression" *(p. 616, italics added).*

Quite unexpectedly research on observing consciousness and the mirror neuron system may be important for the theory, research, and clinical practice of rehabilitation in severely brain-damaged patients and minimally conscious patients (MCS). "The mirror neuron system, which appears to be able to operate independently of conscious cognition," (Stefan et al., 2005, p. 9345) may have profound ethical implications for decision making regarding the continued rehabilitation of patients in coma. The recent case of Terri Schiavo who remained in a coma for 15 years before being taken off of life support raised the issue of the role of observing consciousness, and the limited but intact cognitive capacities, of severely brain-damaged patient. The research of Schiff, Rodriguez-Moreno, Kamal, Ki, Giacino, & Hirsch (2005) now documents how fMRI may be important in such issues as reported in a recent Briefings in Behavioral Science in the Clinician's Research Digest (2005, Vol. 23, 9).

Despite the inability of MCS patients to reliably communicate or follow simple instructions, the cortical networks engaged during listening and touch appear to be somewhat intact. fMRI may prove useful in distinguishing conditions of impaired consciousness and predicting which patients are likely to recover (p. 3, italics added). Research is now needed to explore the use of the ideomotor and ideosensory techniques with minimally conscious patients in rehabilitation (Rossi & Cheek, 1988; Cheek, 1994).

Training Skill Sets Utilizing Hand Mirroring in Therapeutic Hypnosis

While there is currently no research directly relating mirror neurons to therapeutic hypnosis, we have generalized the operation of the mirror neuron system and the clinical implications of the work of Rizzolatti and others in training new skill sets in professional workshops. Rizzolatti's research team, for example, has described how the observation of the hands in "grasping intentions of others" is reflected in "one's own mirror neuron system" as follows (Iacoboni et al., 2005):

> Understanding the intentions of others while watching their actions is a fundamental building block of social behavior. . . *It was proposed early on that*

> *mirror neurons may provide a neural mechanism for understanding the intentions of other people. The mirror neuron mechanism is, in fact, reminiscent of categorical perception (Rossi, 1963; Rossi, 1963, 1964; Rossi & Rossi, 1965]. . . The conventional view on* intention understanding *is that the description of an action and the interpretation of the reason why that action is executed rely on largely different mechanisms.* In contrast, the present data show that the intentions behind the actions of others can be recognized by the motor system using a mirror mechanism. Mirror neurons are thought to recognize the actions of others, by matching the observed action onto its motor counterpart coded by the same neurons [in the observer]. *The present findings strongly suggest that coding the intention associated with the actions of others is based on the activation of a neuronal chain formed by mirror neurons coding the observed motor act and by "logically related" mirror neurons coding the motor acts that are most likely to follow the observed one, in a given context.* To ascribe an intention is to infer a forthcoming new goal, and this is an operation that the motor system does automatically *(p. 533, italics added).*

The operation of the mirror neuron system in the recognition of the "intentions of others"as an "operation that the motor system does automatically" is strongly reminiscent of the analogous use of automaticity, automatisms, involuntariness, dissociation, and the unconscious as explanatory concepts in the historical and current literature of hypnosis (Erickson & Rossi, 2006). Milton H. Erickson (1964/2006), for example, would use "pantomime techniques" and sometimes facilitate the induction of therapeutic hypnosis in "resistant" subjects by surrounding them with highly suggestible subjects whose trance behavior could be carefully observed by the resistant subject. From our current perspective it would seem that Erickson was thereby activating and utilizing the mirror neuron systems of resistant subjects to facilitate their hypnotic induction. The automatic, direct activation of intentions (goals) by the motor system without any apparent intervention of explicit, conscious cognition provides important insights into the essential neural mechanism of ideomotor, ideosensory, and ideodynamic processing in Erickson's hand levitation approaches to hypnotic induction as well as classical finger signaling techniques of mind-body healing in hypnosis (Cheek, 1994; Rossi & Cheek, 1988). A gradual process of simplification has been an important technical ideal in the evolution of the sensory-motor approaches to hand levitation and the induction of therapeutic hypnosis as reviewed in Erickson (1961/2006). We have implemented this ideal by introducing a variety of new skill sets for an activity-dependent approach to hypnotic induction and therapeutic suggestion that is consistent with current neuroscience research on the mirror neuron system and brain plasticity (Rossi, 1986, 2000, 2002, 2004).

Utilizing Mirror Neuron Systems in an Activity-Dependent Approach to Hypnotic Induction and Therapeutic Suggestion

Figure 3 illustrates the utilization of mirror neuron systems in facilitating an activity-dependent approach to the induction of hypnosis and classical 4-stage creative process with ideodynamic therapeutic suggestion (Rossi, 2002, 2004).

Figure 3: Utilizing Mirror Systems in Hypnosis and Therapeutic Suggestion to Facilitate an Activity-Dependent Approach to the 4-Stage Creative Process of Problem Solving, Mind-Body Healing and Rehabilitation.

1. Preparation: Activating Rapport Zones with Ideosensory action. “Place your hands up facing each other about 6 to 8 inches apart [therapist demonstrates]. With great sensitivity, notice what you begin to experience...Is one hand warmer or cooler than the other?...Lighter or heavier?...More or less flexible?...Stronger or weaker? Are your lips, tongue, cheeks or forehead warmer or cooler?”

2. Incubation: Facilitating Creative Replay via the Mirror Neuron System. “Will just one of these hands begin to drift down slowly more or less all by itself to signal that you are reviewing private and even secret memories and feelings related to that issue you want to resolve? Recalling voices? Re-experiencing your own words and thoughts?

3. Illumination: Observing consciousness and the Novelty-Numinosum-Neurogenesis Effect. “Will the other hand now drift down slowly more or less by itself as you explore possibilitiesof healing and problem-solving? Will that hand move down with a will of its own as you receive, creatively replay and talk to yourself about anything new, surprising, unexpected, interesting, curious or important that comes up?”

4. Verification: Awakening with a Posthypnotic Suggestion for Periodic Ultradian Autosuggestion. “Continue saying the words expressing your new ideas and plans to change yourself. When some deep part of knows you can continue this healing activity [problem solving, etc.] at any appropriate time throughout the day and night...what will it be like to awaken refreshed and alert?”

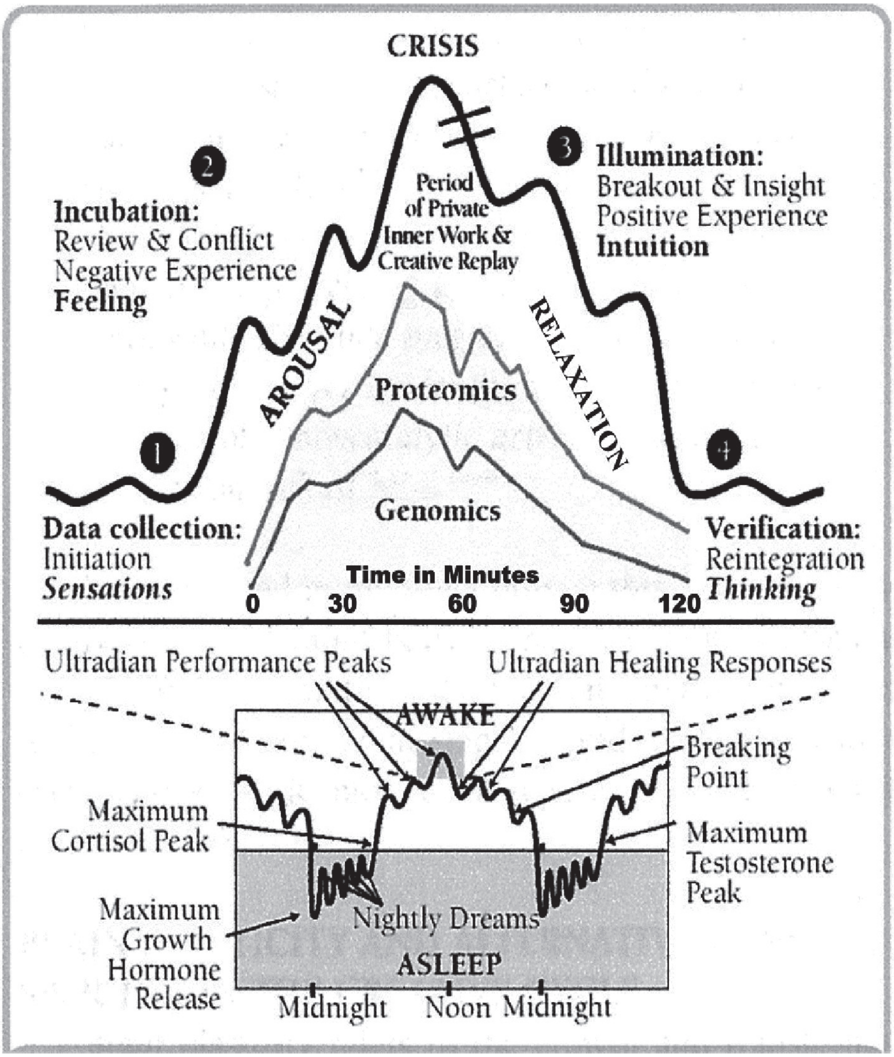
A Neuroscience Rational for Utilizing Mirror Neurons in the Skill Sets of Activity-Dependent Therapeutic Hypnosis and Suggestion

While empirical research is still needed on the efficacy of the activity-dependent approach to creative processing in therapeutic hypnosis and suggestion as outlined in figure 3, the essentials of this skill set have already been used successfully in professional training workshops for more than 2 decades (Rossi, 1986, 1993, 2000, 2002, 2004). Research is now needed to determine whether (1) the neuroscience rational presented in this paper is merely a new metaphor for an old approach to hypnosis or whether (2) there is an experimentally verifiable match between the new neuroscience of psychobiological information transduction proposed in figure 2 and the 4-stage creative process of therapeutic hypnosis outlined in figure 3. Such research would need to assess the correspondences in each stage somewhat as follows:

Stage One: Preparation, Accessing and Activating Rapport Zones with Ideosensory action. The induction of therapeutic hypnosis begins by focusing attention and observing consciousness to activate the mirror neurons of the sensory zones of the sensory-motor homunculus. Notice how the italicized ideosensory suggestions function as *implicit processing heuristics* (Rossi, 2002, 2004) or permissive suggestions for the sensory-perceptual experiences of "warmer or cooler" etc., which are designed to activate the two largest areas of the sensory-motor cortex in the homunculus of figure 1 that map the hands as well as the lips-tongue-cheek area.

Stage Two: Incubation; Facilitating Creative Replay via the Mirror Neuron System. Ideomotor action is now added to "deepen the trance" by engaging and activating the motor zones of the sensory-motor homunculus with the question *"will just one of those hands begin to drift down?"* The following phrase: *"slowly more or less all by itself"* is a permissive, implicit processing heuristic for accessing mirror neuron networks that encode state dependent memory and learning which are at the source of dissociations and conflicts typically expressed as the slow, hesitant and uncertain movements of ideomotor signaling (Rossi, 1986/1993, 2002, 2004; Rossi & Cheek, 1988; Cheek, 1994). The phrase *"you are reviewing some private – even secret – memories related to that issue you want to resolve"* is designed to access and activate the premotor cortex areas associated with the mirror neuron systems of behavioral observation, empathy, and intentionality. The words *"some private – even secret memories"* were one of Erickson's favorite approaches to bypassing resistance to publicly revealing what are the most embarrassing yet important cognitive-emotional blocks to problem solving. The private period of the creative replay of such negative, dissociated, and conflicting experiences facilitates the possibility of breaking through the crisis of confidence between stages two and three of the creative process illustrated in figure 4 (Rossi, 2002, 2004). Notice how the questions: "*Recalling voices? Re-experiencing your own words and thoughts?"* function as implicit processing heuristics directed to activating and facilitating internal speech mediated by the mirror neuron system.

Figure four. A Profile of Erickson's Neuro-Psycho-Physiology During the 4-Stage Creative Process in Therapeutic Hypnosis and Suggestion. The ultradian profile (90-120 minutes) of the 4-stage creative process as it is typically experienced by observing consciousness is illustrated in the top most portion of the upper curve. The proteomics (protein) profile in middle curve depicts the energy landscape for protein folding within neurons of the brain into the correct structures needed for brain plasticity (adapted and redrawn from Cheung et al. 2004). This proteomic profile arises from the functional concordance of co-expressed genes illustrated by the genomics profile below it (adapted from Levsky, et al., 2002). This genomics curve represents the actual gene expression profiles of the immediate-early gene c-fos and 10 other genes (alleles) over the typical Basic Rest-Activity (BRAC) period of 90-120 minutes. The lower diagram illustrates how these ultradian dynamics of the qualia of consciousness are typically experienced as Kleitman's 90-120 minute Basic Rest-Activity Cycle within the normal circadian cycle of waking and sleeping (Rossi, 2002, 2004; Rossi and Nimmons, 1991).



Stage Three: Illumination: Observing Consciousness & the Novelty-Numinosum-Neurogenesis Effect. Ideomotor signalling is utilized to monitor and possibly facilitate the activity-dependent gene-expression/protein synthesis cycle and brain plasticity that is hypothesized as taking place in mirror neurons of the sensory-motor homunculus during this high point of the classical 4-stage creative process (the eureka experience). The novelty and surprise of a creative experience is the phenotypic (outer behavioral) expression of the positive cognitive-emotional experience of the numinosum (fascination, mystery, tremendousness) that often accompanies the molecular-genomic and proteomic (protein) levels as illustrated in figure 4 (Erickson & Rossi, 2006; Rossi, 2002, 2004).

Notice how the permissive questions: "Will the other hand now drift down slowly more or less by itself as you explore possibilities of healing and problem-solving? Will that hand move down with a will of its own as you receive, creatively replay, and talk to yourself about anything new, surprising, unexpected, interesting, curious or important that comes up?" may function as a series of implicit processing heuristics. This series (1) maintains a therapeutic dissociation ("with a will of its own") even while (2) facilitating "creative replay" for problem solving and healing via (3) the "talk to yourself" of the mirror neuron system that is (4) focused on enhancing the Novelty-Numinosum-Neurogenesis Effect with the words: "anything new, surprising, unexpected, interesting, curious or important that comes up" (Erickson & Rossi, 2006; Rossi, 2000, 2002, 2004).

Stage four: Verification: Awakening with a Posthypnotic Suggestion for Periodic Ultradian Autosuggestion. As illustrated in figure 4, Erickson's typical ~90 to 120 minute therapeutic sessions are conceptualized as the utilization of natural ultradian rhythms of the Basic Rest-Activity Cycle (BRAC) that typically occur every 90 to 120 minutes while awake, asleep and dreaming (Lloyd & Rossi, 1992; Rossi & Nimmons, 1991: Rossi, 1996). Likewise the posthypnotic suggestion to *"continue this healing [problem solving, etc.] at any appropriate time throughout the day and night"* is a utilization of the natural BRAC. This association of a posthypnotic suggestion with a behavioral inevitability such as the BRAC was another of Erickson's favorite approaches to enhancing therapeutic suggestion that was a prescient foreshadowing of current neuroscience research on the foundations of Erickson's naturalistic and utilization approach (Erickson & Rossi, 2006).

Summary

Neuroscience has documented the activity of "mirror neurons" in primates and humans that function as neural mechanisms for empathy whereby we understand others by observing their behavior and matching their brain activity patterns. Current research on mirror neurons and empathy is integrated with the history, theory and practice of rapport and therapeutic suggestion in hypnosis. The pioneering research of Pavlov and Platonov, (1955/1959) on "the word as a physiological and therapeutic factor" and "rapport zones" in hypnosis has been updated by tracing their mechanisms to what neuroscience now describes as turning on (activating) the gene expression/protein synthesis cycle and brain plasticity by novel and enrichening psychosocial cues and exercise. This new conceptual integration is generalized in a preliminary outline of an activity-dependent approach to utilizing mirror neuron systems, which function as "rapport zones" in the sensory-motor cortex and other areas of the brain mediating between observing consciousness, the gene expression/protein synthesis cycle, and brain plasticity in therapeutic hypnosis. We propose the concept of mirror neurons as a novel and enrichening didactic device to update the theory, teaching, and training of clinicians with new skill sets for facilitating the practice of therapeutic hypnosis and rehabilitation.

Portions of this paper have been adapted from vol. 8 of the educational set of CDs: The Neuroscience Edition. The Complete Works of Milton H. Erickson, M.D. on Therapeutic Hypnosis, Psychotherapy and Rehabilitation. (Erickson & Rossi, 2006).

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