

The Physiology of Psychotherapy: Past, Present, and Future

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This paper will first locate the physical science of psychology in its historical context and explore the attempt of past eras to devise medical treatments for the mind. Next, present research and clinical applications for the biology of mental disorders will be summarized, with emphasis on the importance of the mirror neuron system. Lastly, overall conclusions will be drawn, and their implications for a truly holistic physiology-informed psychotherapy of the future will be discussed. This paper will ultimately suggest that while promising studies have been conducted on the subject, a considerable amount of work remains in order to surpass the soft embryonic stage of research development and to solidify its position in the science of clinical practice.

The physiology of psychotherapy is a highly relevant issue today. For countless scientist-practitioners and practitioner-scholars who uphold both sides of their respective Boulder and Vail training models, the scientific interconnection of the mind and body is still searching for the right outlet of expression in case conceptualization and clinical practice. Since psychotherapy is an instrument of self-revelation and health-promotion that is capable of benefiting many facets of human life, it must navigate a delicate balance of movement from unconsciousness to consciousness, from the force of self-constriction to the choice of self-liberation, and from poor bodily conditions to positive physical health. Given an assumption of the mind and body as two sides of the same coin, clinicians have often striven in psychotherapy to equally value their clients' mental and physical lives. However, throughout their training in graduate school and beyond, clinicians frequently accumulate as many new questions pertaining to the function of the physical body in "psychotherapy" designed for the mind as they discover answers. These various questions are often incarnations of just one basic inquiry, "What is palpably happening to the patient in a treatment with tangible results?" In the following paper, the answer will be sought through an examination of the physiology of psychotherapy with respect to; (1) the history of psychology, (2) the evolution of different brain regions, (3) the state of present research, (4) its clinical application to mental disorders, (5) the importance of the mirror neuron system, and (6) unique implications for the future.

While most may agree that therapists help their patients cope with or conquer some life problem, it is difficult to explain how without reference to the nebulous process of loose word exchanges in talk therapy. For better or worse, these loose word exchanges comprise a foggy process forever wedged in the illicit border between subjective art and objective science. The physician Laurence Farmer (1950) once denounced the role of clinical therapist as being

an "ill defined psychologist" (p. 175) with poor pseudo-medical training. It might, therefore, be meaningful in one's education to explore the less visible, underlying neurobiology of psychotherapeutic change, given that proper technique can literally alter the patient's body and correct physiological malfunction. Gilbert (1995) once argued that the field of psychology was in a fragile state of disequilibrium from its fragmented uni-dimensional theories opposing body versus mind, and he challenged the field to finally adopt a truly integrative "biopsychosocial" (p. 136) worldview. Now almost a decade into the 21st century, Gilbert's plea has gained great ground, and popular opinion in the psychotherapy community is more supportive than ever of a genuinely comprehensive, holistic framework for humanity.

Historical Roots in the Past

Most societies, beginning from the 5th century B.C. and onward, have recognized a primitive anatomical fact: the brain is the biological apparatus of the mind (Lewis, 1992). In approximately the 4th century B.C., the Greek physician Hippocrates proposed his humoral theory of brain functioning that stated bodily fluids, or physiological humors, are responsible for the psychological disorders of the mind (Durand & Barlow, 2000). By the time of the 17th century, philosopher René Descartes had combined Renaissance ideas with Scientific Revolution notions to form his Cartesian dualism, which effectively divorced the mind from the body as a separate entity for study (Leahey, 2001). Although he was unable to reconcile the seamless interaction of the body and brain with the mind and soul, Descartes resorted to speculations about the pineal gland as their intermediary site, and he even wrote one of the first texts on the subject of physiological psychology, *L'Homme* (Leahey, 2001). Centuries later, the exact relationship between the "brain" and "mind" was still incompletely known, and Freud noted that "data do not include any direct relation between these two terminal points of our knowledge" (quoted in

Cappas, Andres-Hyman, & Davidson, 2005, p. 374). Incremental advances in the physiological sciences today, however, are beginning to illuminate much of the mysterious brain-mind interaction (Lewis, 1992).

Historically, the revolution in the physiological sciences at the inception of the 20th century occurred in tandem with Freud's revolution in the psychological sciences. Freud completed his medical training at the time of the earliest investigations into the neurological configuration of the brain, and his own research on brain physiology is what ultimately narrowed his focus to unconscious phenomenon (Mitchell & Black, 1995). Thereafter, he propounded the first ever psychotherapy to systematically study and mend the mind. With his method wholly unknown to the rest of the world, though, Freud felt compelled to justify psychotherapy as a valid science that was important in its own right independent of medical science. As a result, he adamantly opposed the medicalization of psychotherapy and strove to definitively dissociate psychotherapy from his very own training background in neurophysiology (Mitchell & Black, 1995). Even until the last quarter of the 20th century, many psychologists still interpreted Freud as having exclusively endorsed the study of behavior over the study of biology (Innes, 1971). Consequently, these psychologists largely ignored or neglected the neuro-physiological aspects of psychotherapy practice. On the other end of the clinical spectrum were the medical physicians who dismissed psychotherapy as mere pseudo-medical chicanery, which the psychiatrist Gabbard (2001) called, "a remnant of persistent Cartesian thinking that has led many skeptics to think that psychotherapy may be nothing more than balm for the 'worried well'" (p. 1). Schore (1997) inquired, "A century after Freud's project: Is a rapprochement between psychoanalysis and neurobiology at hand?" and reiterated a rare admission by Freud himself that "we shall have to find a contact point with biology" (p. 807). Indeed, the century subsequent to Freud's era has constructed just such a bridge between biology and psychotherapy and, given the recent trend toward multidisciplinary science, the marriage of physiology and psychotherapy is no doubt one emerging example of the current scientific zeitgeist.

Evolution of the Brain

Considering humanity to be the culmination of 670 million years of animal evolution on the 5-billion-year-old earth (Palmer & Palmer, 2002), it is unsurprising that adaptation, or balanced flexibility, is the natural design for improving fitness between an individual specimen and its environment (Bernard, Mills, Swenson, & Walsh, 2005). Psychotherapy may, in fact, be defined as the *installation of balanced adaptation* through mediation of the lower default brain circuits, or survival instincts, with the higher cortical supra-system circuits, or centers of introspection (Viamontes & Beitman, 2006a). In other words, depending on the patient's problem to be addressed, psychotherapy disentangles the internal conflicts between evolution-

embedded id impulses and social herd-imposed superego restraints to promote negotiation and tolerance of these through the self-aware ego, all of which was Freud's tripartite interpretation of and testament to Charles Darwin's evolutionary theory (Hall, 1961; Leahey, 2001). Treatment with the animalistic id instincts involves the hypothalamus, limbic system, and cingulate gyrus-nucleus accumbens region of the brain for emotion formation, the pleasure of reward or the fear of punishment, and simplistic stimulus-response situations (Ito, 1998; Viamontes & Beitman, 2006b). For the societal superego conscience, treatment involves the parietolateral portion of the association cortex and the orbitofrontal-amygdalar region of the brain for sensorimotor processing and socio-emotional self-regulation (Ito, 1998; Viamontes & Beitman, 2006b). And, treatment with the human's ego self-representation involves the association cortex, sensorimotor cortex, and dorsolateral prefrontal region of the brain for executive control functioning, verbal abstraction, and analytical thinking (Ito, 1998; Viamontes & Beitman, 2006b). The neocortex is one of the most important portions of the human brain which distinguishes it from lower animal brains, and the prefrontal cortex contains 30% of the human neocortex, thereby permitting humans the capacity for goal-directed action, expanded memory, and evaluation of future consequences (Viamontes & Beitman, 2006b). Furthermore, the middle pre-frontal region of the brain is responsible for body regulation of the sympathetic and parasympathetic autonomic nervous systems, fear extinction, impulse inhibition, interpersonal communication, autobiographical knowledge, body awareness, self-reflective insights, empathy or perspective-taking, and pro-social concerns (Siegel, 2006).

The human's frontal lobe began to evolve its proportionately greater size over the great apes' frontal lobe about 20-25 million years ago, but has failed to evolve anymore in the past half-million years (Bernard et al., 2005). Since the prefrontal cortex is the anterior portion of the frontal lobe, the prefrontal cortex has remained largely the same for 500,000 years, too. There are three premier prefrontal cortex circuits in the brain, including the anterior cingulated circuit, the orbitofrontal circuit, and the dorsolateral circuit (Viamontes & Beitman, 2006b). While each of these brain circuits regulate specific parts of the patient's mind during the psychotherapy process, in particular "the dorsolateral circuit is the entry point for verbal psychotherapeutic interventions" (Viamontes & Beitman, 2006b, p. 241), because of its integral role in executive control functions, higher-level logical reasoning, problem-solving, verbal abstraction, and behavioral modification from linguistic input. For instance, depressed people exhibit imbalanced reductions in blood circulation within the right dorsolateral prefrontal cortex as well as inferior parietal cortex (Viamontes & Beitman, 2006b) and, therefore, the clinician's words spoken in psychotherapy directly impact and recalibrate the blood flow imbalances from this pivotal region of the brain.

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Present Research and Applications

Emotional disturbance, such as depression, is one of the most frequent complaints that causes people to seek treatment (Barrera, Torres, & Munoz, 2007), which is thought to assist them in better balancing their maladaptive moods. With magnetic resonance imaging (MRI) and single photon emission computed tomography (SPECT) imaging, psychodynamic psychotherapy for depression has been shown to increase the density of serotonin transporter (SERT) binding at the midbrain sites of the raphe nucleus, which then correlated with the alleviation of depressive symptomatology (Saarinen et al., 2005). Another SPECT study which included a 1-year-long psychodynamic psychotherapy treatment demonstrated increases and ultimate normalization of serotonin metabolism and uptake in a patient suffering from comorbid Major Depressive Disorder and Borderline Personality Disorder (Viinamaki, Kuikka, Tiihonen, & Lehtonen, 1998). Cognitive behavior therapy has indicated success in decreasing and normalizing thyroid hormone levels of thyroxine (T4) in depressed patients (Joffe, Segal, & Singer, 1996). In another study with persons affected by negative emotions, it was learned that having the patients rename their emotional circumstances in unemotional words effectively decreased their negative emotional state, which involved stimulation of the lateral and medial prefrontal cortices in conjunction with de-stimulation of the amygdala as well as medial orbitofrontal cortex (Viamontes & Beitman, 2006b).

Imaging research has also demonstrated that the amygdala and orbitofrontal circuits, which help control emotional stability, can be successfully altered through the self-awareness thought processes within psychotherapy (Viamontes & Beitman, 2006b). Past research has shown that anxiety relief and decreases in parasympathetic heart measures, like heart rate and variability from electrocardiogram (EKG) recordings, are correlated during therapy with positive self-talk by patients, as well as correlated with simply speaking about the therapy when contrasted with patients' critical self-evaluations (Anderson, 1956). The psychotherapeutic journey from unresolved anger and internal rage to feelings of depression and sadness depends upon sympathetic system activation, such as an increase in temperature of fingers and skin conduction, whereas parasympathetic system arousal, like high consistency of heart rate variation of between-beat intervals, corresponds to sadness elicited before the inducement of anger in therapy (Rochman & Diamond, 2008). A physiological study of psychotherapy found that clients' feelings of uncomfortable tension with the therapist were manifested in the client's increased heart rate, whereas feelings of antagonism against the therapist were manifested in the client's increased skin temperature (Dimascio, Boyd, & Greenblatt, 1957).

As a result, intentionally impacting bodily markers, such as deliberately decreasing clients' body temperature and reducing their heart rate among other vital signs, may be a

relevant auxiliary goal of treatment. The "process of therapy may need to involve working through the anger to reach the pain" (Rochman & Diamond, 2008, p. 103), such that certain sympathetic system deactivations correlate with the process of arousing buried rage and then gently opening the patient to their associated sorrow. However, the reverse direction does not effectively decrease sympathetic activity, by first shifting from initial sadness to later anger (Rochman & Diamond, 2008), and should therefore be avoided by psychotherapists. In addition, when research subjects verbally discussed their feelings of rage, their sympathetic activity changes correlated with their self-reports of rage intensity, whereas when patients suffered silently without verbalizing depressive feelings, their parasympathetic system increases corresponded to their self-reports of depression intensity (Rochman & Diamond, 2008). Given the neurological corollaries of emotional verbalization, psychoanalytic authors have declared that defense mechanisms, such as regression and repression, can be neurologically located at the brain sites of neurotransmitters with aversive, noradrenergic, and serotonergic reward stations (Heilbrunn, 1979).

Self-awareness is dependent in psychotherapy upon the right prefrontal cortical region, although transcranial magnetic stimulation of this brain region interrupts self-awareness, which evolved alongside the right hemisphere and its cognitive capacities (Guise et al., 2007). It has been noted, however, that disturbances of self-awareness and first-hand perspectives in the right prefrontal cortical region do not impede other-awareness or second-person perspectives (Guise et al., 2007). Thus, this region is implicated in the ability of patients to understand the therapist's perspective when he or she empathically interprets to the patient, based upon the therapist's own right prefrontal cortical region for understanding the patient's perspective. Furthermore, functional imaging research has demonstrated that stimulation of the left prefrontal cortex region is indispensable in the semantic processing of first-person perspectives as well as second-person perspectives, although the medial prefrontal cortex region is connected to self-reference features in the human memory system (Heatherton, Macrae, & Kelley, 2004). The path of memory consolidation resulting in greater adjustment of synaptic plasticity is the main mechanism of information acquisition, retention, and storage for what is learned in psychological treatment (Liggin & Kay, 1999). Therefore, psychotherapy that stimulates left regions as well as medial regions of the prefrontal cortex will be most successful in certain treatment cases, while other situations may demand more activation of the right region of the prefrontal cortex, as in the case of panic and phobias.

One physiological study on psychotherapy for arachnophobia determined that linguistic-based cognitive therapy was effective through activation of the prefrontal cortex area, particularly on the right side, during exposure to spiders (Johanson, Risberg, Tucker, & Gustafson, 2006). Successful post-treatment patients, who earlier had both

phobias and panic attacks in the presence of spiders, displayed an increase of regional cerebral blood flow in the dorso-lateral frontal cortex and enhancement of neocortical modulation for limbic reactions when in the later presence of spiders (Johanson et al., 2006). Successful post-treatment patients, who earlier had phobias with no panic attacks in the presence of spiders, displayed a decrease of regional cerebral blood flow in the prefrontal cortex, particularly in the right hemisphere, because they now demanded less strenuous self-management of their reduced emotional response to the noxious stimuli of spiders (Johanson et al., 2006). For obsessive-compulsive disorder, behavior therapy engendered comparable reductions in cerebral metabolic rates of glucose in the right caudate nucleus as did pharmacological treatment with fluoxetine (Gabbard, 2000). In addition to the treatment of phobias, obsessions, and compulsions, the treatment of impulsive aggression (including violent offenses), the treatment of sexual compulsion, and the treatment of eating disorders may all rely upon activation of the prefrontal cortex (Carlson, 2007). Specifically, the treatment of impulsive aggression may entail the elevation of serotonergic input as well as serotonin transporters into the medial and ventral prefrontal cortex (Carlson, 2007). The treatment of sexual compulsion may entail the stimulation of the right prefrontal cortex, which could inhibit sexual arousal and prevent inappropriate stimulation of the limbic system. Lastly, the treatment of eating disorders may entail deactivation of the left medial prefrontal cortex, because this brain region appears over-activated in anorexic and bulimic persons (Carlson, 2007).

There is research evidence to suggest that prefrontal and frontal region executive dysfunction may be in part responsible for low treatment success among substance abusers, because these patients' neuro-cognitive capacities such as attention, impulse inhibition, language, novel learning, and goal planning are impaired (Weinstein & Shaffer, 1993). The neural substrates of the medial prefrontal, the orbitofrontal, and the premotor cortices are believed to be responsible for the sensorimotor regression symptoms known as catatonia, which many psychoanalysts consider a defense mechanism of schizophrenia (Northoff, Bermpohl, Schoeneich, & Boeker, 2007). Yet certain other difficulties, such as problems with basic attachment and interpersonal relatedness, may lead to the development of personality disorders, most notably Borderline Personality Disorder (BPD). For BPD, psychotherapy must address the mesocorticolimbic dopamine pathways, as well as the anterior hypothalamus vasopressin circuits connected to the nucleus accumbens and ventral tegmental area, in addition to the dorsal cingulate cortex, the middle insula, and the striatum (Fonagy & Bateman, 2006). These brain regions are wired to the prefrontal cortex, and "the prefrontal cortex may activate the reinforcement system when it detects that the animal's behavior is resulting in progress toward a goal. But the prefrontal cortex is a target of dopaminergic neurons as well as a source of their control" (Carlson, 2007, p. 458). Positive attachments, like the therapeutic relationship, are

essential to patient improvement (Cappas et al., 2005), and these intimate relationships activate the neuropeptide hormones oxytocin and vasopressin for attachment as well as the mesocorticolimbic dopaminergic pathways for positive self-reinforcement (Fonagy & Bateman, 2006). Hence, various psychological disorders require the therapist's attention be paid to the most relevant brain sites from where dysfunctions arise and from where rewards for positive relationship behaviors accrue, which is typically the prefrontal cortex.

While much remains to be learned about how the material "brain" manifests as the immaterial "mind" and, by consequence, what the physiology of psychotherapy is, significant technological advances have nevertheless been made. Although some neurobiological psychologists misconstrue contemporary research as a physiological rebuttal against and replacement for the allegedly antiquated notion of the unconscious (Grotstein, 1999), it is widely accepted that the brain perceives as well as processes unconscious and non-linguistic data (Cappas et al., 2005). It is further recognized that stimulation of the right prefrontal cortex alone provides non-linguistic knowledge of emotion from a patient's or therapist's voice intonation, rather than linguistic speech content (Carlson, 2007). Also, the anterior paracingulate cortex of the prefrontal cortical area is responsible for the comprehension of others' intentions during social transactions (Walter et al., 2004) which, in the context of psychotherapy, are essential for the patient and therapist to mutually understand each other's motives and the effects of perceived motives. Finally, the inferior parietal cortex and right hemisphere prefrontal cortex are instrumentally involved with psychological identification, dis-identification, counter-identification, and projective identification mechanisms (Decety & Chaminade, 2003), and so must be treated by the clinician with surgical care.

Mirror Neuron System

One person's mere observation of another's emotional expression activates the same neural pathways in the observer's brain as in the emotionally expressive person's brain (Viamontes & Beitman, 2006a). Nerve cells known as "mirror neurons" enable the therapist to empathically experience the patient's maladaptive emotional states (Carlson, 2007), while the therapist simultaneously attempts to balance these states through intentional activation of the patient's mirror neuron system (MNS). Harvard biomedical imaging research has documented that cortical thinning of gray matter in the MNS region is associated with autism symptomatology and severity (Hadjikhani, Joseph, Snyder, & Tager-Flusberg, 2006), for which reason autism spectrum disorder (ASD) patients often lack the empathy and perspective-taking faculties imparted from the MNS (Martineau, Cochin, Magne, & Barthelemy, 2008; Oberman & Ramachandran, 2007). Italian neuroscience researchers, Rizzolatti and Gallese, were the first to haphazardly discover mirror neurons in the physiology of the brain and,

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surprisingly, this accident did not occur until the 1990s (Rothschild, 2004). The reason is that, although neuroscientists had identified empathy's *effect* on the brain, no researcher had thought to search for empathy's *cause* in the brain (Rothschild, 2004). But with the anatomical root of empathy now known to be the mirror neuron system, the MNS possesses the potential, in the opinion of famous neuroscientist V. S. Ramachandran, to usher in and welcome the next major Copernican-like revolution for psychology, similar to the previous revolutions of Darwin's evolution and Freud's psychoanalysis (Rothschild, 2004).

The mirror neuron system, located in the fronto-parietal circuit, pre-motor cortex, and superior-temporal sulcus of the brain (Carr, Iacoboni, Dubeau, Mazziotta, & Lenzi, 2003; Martineau et al., 2008; Molnar-Szakacs, Kaplan, Greenfield, & Iacoboni, 2006), is what scientists depict as the neurological "execution-observation matching system...[of] action recognition" (Buccino, Binkofski, & Riggio, 2004, p. 370). In other words, the MNS internally recreates and represents to the same degree of complexity the intricate qualities of the external world, and "the mirror neuron system provides a fairly accurate simulation process of observed actions, mimicking internally the level of motoric complexity" (Molnar-Szakacs et al., 2006, p. 923). Moreover, all behavioral action utilizes the exact same physiological substrates in the inferior parietal lobule as the internal perception of such action (Rizzolatti, Ferrari, Rozzi, & Fogassi, 2006), which has myriad ramifications for psychotherapy. For example, mirror neurons may explain the phenomenon of negative therapist experiences known as "compassion fatigue" and "vicarious trauma" when listening to patients' profoundly abusive and painful life events (Rothschild, 2004). Psychoanalytic writers have suggested that mirror neurons represent the neurological source of such psychological mechanisms as identification and imitation (Olds, 2006). Indeed, the fronto-parietal, pre-motor cortical, and superior-temporal mirror neurons contribute an entirely new element of understanding to the psychodynamics of altruism, attachment, displacement, empathy, introjection, projection, reaction formation, transference, and countertransference, among other phenomenon. Due to the mirror neuron system and its accordant internal motor simulation, the observation of others' behavior can disrupt one's own behavior (Shmuelof & Zohary, 2007), or can presumably improve one's behavior if in psychotherapy, because the MNS permits humans to learn by action imitation and behavioral understanding (Rizzolatti & Craighero, 2004).

The dysgranular field of the insular lobe has links not only to the main brain regions containing the MNS but also to the limbic system, thus interconnecting the compounded action-perception mechanism with the primary emotional processing operation (Carr et al., 2003). Therapists must rely upon this insular lobe interconnection to produce their empathic resonance and subsequent response to patients in treatment. However, therapists must learn to engage their patients' amygdalar zone, anterior insular circuit, and

superior temporal sulcus, because these regions are more highly activated by the imitation of facial affect than by the mere observation of such emotional expression (Carr et al., 2003). The therapist must, therefore, successfully model adaptive stability for emotionally imbalanced patients, who may need to imitate or introject the therapist's affective behavior. The anterior insular circuit also helps supervise one's motoric self-control and personal agency (Carr et al., 2003), so that empathy might be intimately related to one's executive sense of self. For example, socially-deficient patients may learn to empathize with others just as their therapist empathizes with them.

McWilliams (1999) has depicted psychotherapy as "the science of subjectivity, in which the analyst's empathy is the primary tool of investigation" (p. 2). But not only does the therapist employ empathy as a fundamental tool of treatment, empathy also serves as its fundamental goal. Yalom (2003) suggested that clinicians must "help patients develop empathy for others" (p. 23) by enabling them to identify with and duplicate the empathy expressed by the therapist for the patient. If empathy is regarded as a form of love, then "therapy is essentially an attempt to help the patient gain or regain his capacity for love" (Fromm, 1972, p. 84). This is congruent with Freud's dual claims that therapy both cures the patient through the experience of love and creates love in the patient for others (McWilliams, 1999; Welwood, 2000). Given the contingency of psychotherapy on the MNS, effective treatment will equip patients' mirror neuron systems to more appropriately reflect their feelings and empathically respond to other persons.

Conclusion and Future Implications

Hence, physiology-informed psychotherapy might be viewed as a form of socio-linguistic *biofeedback*, whereby the therapist's mirror neuronal output constructs a closed feedback loop with the patient's mirror neuronal input as part of a reciprocal chemical interaction cycle. Moreover, this model of treatment would understand the therapeutic relationship as a shared *mindfulness meditation*, in which both persons' brain waves and body rhythms would symbiotically adapt and synchronously balance through clinically meaningful verbal or non-verbal exchanges to achieve homeostasis in the patient. The therapeutic atmosphere and environmental output offered by the clinician in the treatment room may also positively change the dormant gene expression of patients, by directing the transcriptional function of their protein manufacturing in relevant genes and guiding their synaptic interconnections (Gabbard, 2000). This would further serve to increase the stress threshold of one's genetic vulnerabilities and help promote protective factors in people predisposed to mental illness (Gabbard, 2000), in accordance with the diathesis stress model. Both biofeedback, which predominantly engages the analytical and linear functions of the left hemisphere in the brain, and mindfulness meditation, which predominantly engages the contextual and intuitive functions

of the right hemisphere, comprise two different quintessential methods for pursuing neurobiological changes and similar treatment outcomes (Shapiro & Zifferblatt, 1976). Eastern mindfulness “meditation and Western [bio]feedback and voluntary control produce the same end results” (p. 96), as noted in the psychiatric research of Tomio Hirai (1989) from the University of Tokyo.

Mindfulness meditation, which has existed for more than 2 millennia but only in the last century became an object for scientific study outside of Eastern religions, may be defined as the sustained purposeful awareness of one’s present mental and physical experience with non-judgmental acceptance (Germer, Siegel, & Fulton, 2005). Several authors have designated the construct of mindfulness as among the most fundamental “common factors” of all successful psychotherapies, regardless of theoretical orientation (Germer et al., 2005; Martin, 1997; 2002), because the mindfulness process involves a deepening awareness of how the brain, body, and mind mutually interact to promote health or restoration at each entry point. Meditation techniques have been incorporated with great success into a number of extant treatments, including Cognitive-Behavioral Therapy (Hayes, Follette, & Linehan, 2004; Roemer & Orsillo, 2002; Segal, Williams, & Teasdale, 2002), Dialectical Behavior Therapy (Linehan, 1993; Robins, 2002), Rational Emotive Behavior Therapy (Whitfield, 2006), and Psychoanalytic-Psychodynamic Therapy (Fromm, Suzuki, & DeMartino, 1960; Molino, 1998; Safran, 2003; Suler, 1993). The practice of mindfulness by therapists can even increase their empathic attunement with patients (Lesh, 1970; Shapiro, Schwartz, & Bonner, 1998) and, as a result, improve the affective performance of the therapist’s MNS and its emotional reverberation with the patient’s MNS. Mindfulness works in large part through the de-automatization of habitually learned responses to particular punishment-reward contingencies, which is the same correctional mechanism operating in biofeedback training that promotes volitional control over preprogrammed, unconscious reactions (Bogart, 1991; Brown, Ryan, & Creswell, 2007; Shapiro & Zifferblatt, 1976). Meditation exercise impacts blood pressure, brain waves, heart rate and variability, muscle tension, respiration patterns, skin temperature, and sweat gland activities all in a similar fashion to biofeedback (Hirai, 1989; Lehrer, 2003; Zeier, 1984).

Since its first experiments a half-century ago, biofeedback training has utilized computer equipment to relay information back in real-time to clients about their autonomic nervous system functions and directions for physiological change (Lehrer, 2003). Biofeedback may be viewed as the Cartesian convergence of clients’ first-person neurobiology and clinicians’ third-party perspective of external phenomena in therapy. As one clinician stated, “BF [biofeedback] modifies the basic client-therapist relationship, introducing a new dimension- the client’s physiology- as a 3rd component of the important interactive processes” (Watral, 1984, p. 11). Biofeedback research, thus, becomes

an efficient tool for optimizing the therapeutic alliance and behavioral techniques while studying the client’s neurobiology during the process of psychological adjustment. The best current example of a professional discipline highlighting the physiology of psychotherapy is Applied Psychophysiology (AP), which divides its bipartite treatment approach into the complementary methods of biofeedback and meditation (Lehrer, 2003). But AP is concerned with preserving the ideological purity of its theory, and it considers traditional talk therapy to be a territory infringement. Prominent practitioner M. S. Schwartz (1999), for example, claimed that to simply compare Applied Psychophysiology with conventional psychotherapy would render AP “useless” (p. 8). Until empirical evidence demonstrates so, in the words of practitioner J. P. Rosenfeld (1999), traditional psychotherapy interventions “are *implicitly* psycho-physiological interventions, but *explicitly* non-physiological” (p. 34). They therefore feel comfortable employing techniques from behavior and body-based treatments, yet reject talk therapies because they are apparently not physically conscious enough. Although the merits of such reasoning is debatable, it is nevertheless clear impetus for other treatment modalities to more “*explicitly*” address the neurobiological process supporting their clinical practice, so as to better facilitate the fateful matrimony of physiology with psychotherapy.

Future research in this area may have influential repercussions for the greater integration of a truly holistic, physiology-informed psychotherapy of tomorrow. This might include concrete biological interventions that therapists can employ *exclusively* through verbalized words and non-verbal body language, as well as neurological insight into the patient’s transference and the therapist’s countertransference as the treatment process purposefully reinforces rather than blindly explores new mirror neuronal pathways. Now that the 20th century has established talk-therapy as a credible linguistic technology, the 21st century cultural zeitgeist might be to better integrate the world’s multidisciplinary sciences, in terms of the mental health profession, through a mutually enriching relationship between physiology and psychotherapy that produces improved bio-psycho-social benefits to clientele. Psychological problems can be addressed concomitantly from physiological perspectives, for instance, therapeutic engagement of the prefrontal cortex and frontal lobe regions are known to be critical for success in most treatments. Likewise, therapeutic activation of the neuropeptide hormones oxytocin and vasopressin for social attachment, as well as the mesocorticolimbic and prefrontal cortical dopaminergic pathways for positive reinforcement, also appear critical for treatment success. All of these biological processes constitute part of what is palpably happening to the patient in a treatment with tangible results, if one were to answer the opening question originally posed. This paper has examined the physiology of psychotherapy with respect to; (1) the history of psychology, (2) the evolution of different brain regions, (3) the state of present research, (4) its clinical

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application to mental disorders, (5) the importance of the mirror neuron system, (6) and unique implications for the future. An abundance of promising trends can direct the trajectory for scientific progress in this arena, and clinicians can learn therapeutic techniques that impact the physical provinces of the brain and body as part of a genuinely comprehensive, physiology-informed psychotherapy of the new century, whose frontier is waiting to be pioneered.

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