Chapter 5

A Fractal Epistemology as an Integrative Framework for Research and Practice in Psychodynamic Psychotherapy

Terry Marks-Tarlow[1], PhD
and Yakov Shapiro[2,*], MD
[1]Pacifica Graduate Institute, Santa Barbara, California and California Institute of Integral Studies, San Francisco, California, USA
[2]Department of Psychiatry, University of Alberta, Edmonton, Canada

Abstract

This chapter proposes a new conceptual framework for psychodynamic and psychoanalytic psychotherapy practice and research that serves to bridge the conceptual divides inherent in Cartesian and reductionist frameworks, such as brain vs. mind, objective vs. subjective, rational vs. intuitive, conscious vs. unconscious, and personal vs. transpersonal domains. We examine a set of fractal principles derived from contemporary nonlinear science that capture the brain/mind/body as a unitary, complex adaptive system (CAS) defined in informational language that applies to both brain- and mind processes. A fractal approach offers a unique potential to build a conceptual bridge between biological and psychological perspectives, helping us to expand the reductionist paradigm. This rigorously systemic approach captures biopsychosocial evolution on the phylogenetic and ontogenetic scales while helping to define our patients as persons endowed with a capacity to create meaning in the process of interacting with each other and the world at large. Fractal consciousness is based on the clinician's ability to identify self-similar but scale-invariant patterns that characterize the patient's subjective and interpersonal experience. The perspective is flexible enough to accommodate ambiguity, paradox, and uncertainty inherent in the therapeutic interaction and wider social issues such as polarized politics and gender stereotypes. This holistic framework enables observer-dependent measurement of complex, unique, and nonlinear events while accommodating porous boundaries and the emergent patterns of perception, feeling, thinking, and relating across the objective-subjective divide.

Keywords: complexity, fractal, meta-reductive, nonlinear dynamics, psychodynamic psychotherapy

* Corresponding Author's Email: yshapiro@ualberta.ca.

In: Psychodynamic Psychotherapy: A Global Perspective
Editor: Yakov Shapiro, M.D
ISBN: 979-8-89113-977-0

Introduction: Towards a Meta-Reductive Natural Science

The history of Western science dates back over two millennia to the philosophers of early Greek antiquity, whose teachings in formal logic, geometry, the empirical method, and observational techniques were only re-discovered in the early sixteenth century. At that time, Francis Bacon, Galileo and René Descartes formalized the contemporary scientific method, which replaced a priori postulates with formal hypothesis testing to usher in the age of empirical science. Descartes' three-step reductionist method was based on the sequence of *reduction* of the whole into its constituent parts; *analysis* of the parts involved; and *synthesis* of the now understood parts back into the whole. In the four centuries since its inception, reductionist science has led to unprecedented leaps in our ability to understand and control the world around us, forming the very foundation of technological society as we know it.

The prevalent reductionist approach in natural science presumes that all complex phenomena in nature can be understood by dividing them into constituent elements and analyzing each element separately to understand how the collective processes work. For instance, we can apply Newton's laws of motion to calculate the orbits of every planetary body in the solar system just as easily as to calculate the escape velocity of the SpaceX rocket, the trajectory of a baseball strike, or rotational velocities of distant galaxies. The same philosophy was adopted in biological sciences, such as studying the behavior of an individual cell and extrapolating the findings to the entire organism. In so doing, the reductionist picture of the world builds upon Newton's notion of a clockwork Universe, where all processes operate in a mechanistic and linear fashion, and where the whole is always equal to the sum of its parts. In this view, all complex phenomena are divisible into simpler elements with distinct boundaries that cleanly separate the processes they encompass from phenomena external to them, and systemic evolution moves in graduated steps, smoothly and continuously.

Reductionist assumptions worked so well that by the early 20th century, dreams of complete knowledge of deterministic Nature were well established. Yet, as science progressed and humankind stretched its reach into atomic, cosmological, and complex systems domains, the reductionist logic began to reach its limits (Marks-Tarlow, 2003). At the global scale, Einstein introduced relativity equations that unified space and time but demonstrated these seemingly absolute domains to be nonlinear and observer-dependent. At the quantum scale, paradoxes appeared in the fundamental nature of material reality that defined inherent limitations to our knowledge at the micro-scale, where the very substance of solid matter dissolves into informational processes without discrete location or trajectory until they are measured. Subsequent elaboration of quantum entanglement[1] shows that the world we live in is fundamentally *nonlocal* (interconnected across vast distances of space), transcending classical cause-effect relations and making complete and certain knowledge untenable even in principle.

Reductionist assumptions privilege the separate quality of each phenomenon at the expense of its relational and collective aspects. They remain useful for manipulating mechanical objects but hit severe limitations in dealing with complex systems, both inorganic and organic. The recent field of *complexity science* (Peletier et al. 2019; Per Bak, 2013; Waldrop, 1993)

[1] Entanglement describes nonlocal correlations, where one part of a quantum system is instantaneously correlated with the measurement of another part, irrespective of the physical distance between them. Multiple experimental verifications have now demonstrated that our universe is fundamentally nonlocal, and entanglement can occur not just at subatomic but also classical scales (Lin et al., 2020).

counterbalances reductive logic with fundamental collective principles, such as *self-organization*, *sensitivity to initial conditions*, and *emergence*[2], where the whole becomes greater than the sum of its parts, and the system's evolution is unpredictable from the outcome. The elaboration of nonlinear dynamics inherent in chaos and complexity theories in the late 20th century brought into focus the abundance of nonlinear processes in the world around us (Feldman, 2020). Weather systems, neural networks, perception-action coupling, social behavior, and stock market dynamics all exhibit the property of *nonlinearity,* where the system's sensitive dependence on initial conditions renders precise predictions of systemic behavior fundamentally impossible (the so-called Butterfly effect[3]). A similar picture became evident in the elaboration Darwinian evolution, where novel collective principles and laws emerge at higher levels of organization (think of locomotion, which arose with the evolution of living cells, or group dynamics in the evolution of multicellular organisms). By the end of the 20th century, the epistemological container of reductionism had broken open. Ilya Prigogine (1997), the Nobel biophysicist and one of the originators of complexity theory, hailed the advent of nonlinear dynamics as the end of the deterministic clockwork Universe—a reductionist illusion that never existed in the real world.

In keeping with these scientific advances, new *meta-reductive* scientific approaches have come to the forefront in the past four decades that incorporate the reductionist framework as a special case and enable more wholistic understandings of natural systems. These methods complement the reductionist assumptions with an *emergent perspective* that allows for the evolution of novel levels of collective organization that causally impact lower-level processes (Laughlin, 2005). For instance, not only can physiological and structural changes in the brain result in altered subjective phenomenology, as in classical reductionist neuroscience, but novel experiences in psychotherapy can change the very structure of neural networks, the findings now demonstrated with neuroimaging techniques (Beauregard, 2007). Viewed in this light, emergent processes at higher levels of organization have direct causal impact on the processes at lower levels (think of cyberbullying that may result in clinically significant depression and corresponding alterations in brain physiology).

Complexity Science in Psychology

Unfortunately, the domains of mind and consciousness (Descartes' *res cogitans*) were left out of the Renaissance scientific endeavor that only focused on *res extensa*, or material reality. Despite great strides in our understanding of the brain as a seat of consciousness, including cognitive, affective, social, and cultural neuroscience in the last half century, vestiges of

[2] *Self-organization* refers to global order or coordination that arises from local interactions among the system's components, without control by any external directing influence. *Sensitivity to initial conditions* is a concept particularly prominent in the study of chaotic systems and means that small differences in the initial state of a system can lead to vastly different outcomes over time. *Emergence* refers to systemic patterns or behaviors that arise through interactions among the system components that themselves do not exhibit such properties.

[3] The Butterfly effect (Lorenz, 2000; Vernon, 2017) exemplifies chaotic behavior in complex nonlinear systems. It is based on extreme sensitivity to initial conditions, where minute changes in a complex system's parameters amplify over time and result in widely divergent trajectories in its behavior because composite elements continually interact with each other. The Butterfly effect applies to both inorganic (weather systems), biological (neural network dynamics), and social/technological (stock market) processes.

Cartesian dualism continue to perpetuate the split between biological and psychological domains in clinical practice and research (Damasio, 2008).

Compared with the broad timespan for science as a whole, the field of clinical psychology dates back just over 150 years to the landmark contributions of Wilhelm Wundt, who was the first to define the discipline of psychology, and William James, who identified the categories of mental processes in his groundbreaking *Principles of Psychology* (1863/2007), which are still in use today (Mandler, 2011). The forefathers of psychotherapy in the nineteenth century included Pierre Janet, who studied mechanisms of hysteria and dissociation (van der Kolk & van der Hart, 1989); Sigmund Freud (1895/2004), who formalized the study of the unconscious and the field of psychoanalysis; and Carl Jung, who developed the concepts of collective unconscious.

In the early 20th century, the subjective vicissitudes of psychoanalytic schools triggered a counterreaction evident in the emergence of behaviorism and fledgling neuroscience, which treated subjective experience and free will as an irrelevant "black box" or epiphenomenal illusion, spelling out the reductionist paradox: "I think, therefore I am *not*" (Shapiro & Scott, 2018). This led some psychotherapy theorists and practitioners to reject empirical science altogether in favor of hermeneutics, or subjective/intersubjective meaning-making as the heart of the discipline (Steele, 1979). Unfortunately, when hermeneutics is pitted against empirical science, such attempts only illustrate the other side of the reductionist coin, substituting downward reduction of conscious experience to the material brain for the upward reduction of neurophysiological foundations to the constructivist theorizing, sacrificing the whole richness and complexity of the lived experience, which is necessarily embodied and incorporates both physiological and psychological domains (Varela & Thompson, 1992).

A suffering person cannot be understood as a mindless brain any more than a brainless mind. This basic truth in clinical practice brings into focus the need to incorporate a wholistic perspective of a complex *brain/mind/body system* and its adaptive interactions within physical, cultural, and social environments. Today, both within and outside the field of psychology, a paradigm shift toward a meta-reductive framework more befitting of natural systemic complexity is necessary for a more fruitful collaboration between natural and "soft" psychological and social sciences, including the interface between neuroscience and psychotherapy (Shapiro & Scott, 2018). Meta-reductive perspectives eliminate the need to polarize subjective against objective methods, treating these dimensions as complementary, depending on the level of observation. Meta-reductive approaches that combine hermeneutics with empirical methodology can integrate processes of the mind with those of neural network dynamics and overt behavior in order to capture the full complexity within psychological research.

One theoretical direction for expanding the reductionist framework in psychology and psychiatry involves nonlinear dynamics and complexity science. These newer disciplines operate with *informational language*, which has the power to unify observable neural network processes in the brain with subjective patterns of perception, feeling, and thinking, and intersubjective patterns of relating to others and to the world at large. A meta-reductive complexity approach operates with a radically different set of assumptions compared to reductionist science alone:

1. Complex adaptive systems (CAS), such as brain/body/mind evolve and *self-organize* in non-linear ways to exchange energy, matter, and information with their

environment. Small perturbations in individual development and psychotherapy can result in large effects, while large perturbations may have little or no effect at all. Precise trajectories in nonlinear systems are unpredictable, even in principle. In clinical work, a well-timed intervention can be life-changing to a patient, while multiple poorly timed interventions may have no impact at all. For example, a 71-year-old man spent decades rehashing his distant past over and over compulsively in his mind, day after day. While during the first phase of therapy, he appeared insensitive to his therapist's interpretations, he subsequently felt transformed by the notion that each individual tends to 'lean' either toward the past, which is often accompanied by depression, or toward the future, which is often accompanied by anxiety. This new awareness allowed him to move from a relatively passive stance of allowing the world to dictate his plight – to a more proactive stance of identifying and embodying his own intentions and vision.

2. While fundamentally uncertain, systemic outcomes form predictable patterns of meta-stability described as *attractor dynamics* (see Fig. 4). Consider a patient with chemical or behavioral addictions, where specific context and timing of the next recurrence is unpredictable but the probability of going back to the problem behavior and its adverse impact on the patient is highly likely in the absence of consistent treatment.
3. Evolution of complex systems is characterized by gradual quantitative phases alternating with abrupt emergence of qualitatively new configurations (new attractor basins) that impact lower-level processes. Consider a gradual process of skills acquisition, such as in music playing, which consists of a series of stagnant plateaus leading to a qualitatively novel phase of procedural mastery. We can also observe such emergence in anticipated but unpredictable shifts of infant development, such as transition to walking or language acquisition (Thelen, 2005). In each case, the emergence of a new level of procedural mastery heralds qualitative change points, where underlying elements reorganize to allow for new patterns of behavior. In psychotherapy, transitions may be manifested as flashbulb "aha moments" of mastery and insight, or as qualitative shifts in dysfunctional patterns of perceiving, feeling, thinking, and relating that bring the patient to therapy.
4. Systemic processes involve *emergent dynamics*, where the whole is more than the sum of its parts, such that novel collective levels of organization are not pre-determined by their constituent components but also their inter-relationships with each other. Higher level coordination dynamics can also impact the behavior of the system elements through top-down causal links (Jirsa & Kelso, 2004). Thus, the person of our patient is more than their diagnoses, brain physiology, cognitive or relational styles. Holistic properties make reverse engineering impossible—we cannot understand lived experience by chopping up people into their constituent bits. In psychotherapy, emergent dynamics become evident the greater the intimacy and safety between therapist and patient. When each attends to the other with an open and receptive, non-defensive stance, the relationship then takes on a life of its own, carrying both participants to new and unpredictable places emotionally, cognitively, and even spiritually.
5. Complex processes operate with *fuzzy boundaries*, where the whole is composed of interpenetrating parts that cannot be cleanly separated from each other (such as in brain/mind complementarity, perceptual binding, or social identity). This is an

> important feature of natural systems (Marks-Tarlow et al., 2020), where boundaries are rarely clean and often serve as filters that allow for selective exchange (think of a cell membrane). Psychological boundaries between two different subjectivities are a good example: each person filters information according to their own perspective, such that some of what the other person intends (or does not intend) to communicate will pass through, but not all. In psychotherapy, fuzzy boundaries are especially evident at the nonverbal, somatic level, where the bodies, minds, and brains of therapist and patient can move into synchrony with one another, often beneath the level of conscious awareness. In this case, porous boundaries existing at the somatic level, can translate into feelings of trust, attunement, and 'feeling understood' at the emotional level.

Chaos and complexity sciences have been slow to penetrate into the field of psychology. The Society for Chaos Theory in Psychology was formed in 1991 and its journal, *Nonlinear Dynamics, Psychology, and Life Sciences* began publication in 1997. Psychologist Esther Thelen was among the first to pioneer a dynamical systems approach to child development (Thelen & Smith, 1994). In the last three decades, nonlinear dynamics has been instrumental in understanding the mechanisms of perception-action coupling (Gangopadhyay & Schilbach, 1992); memory consolidation (Lane et al. 2015); and synchronization patterns in the brain (Buzsaki, 2006), as well as between two or more brains (Kinreich et al. 2017).

One advantage to nonlinear approaches is that they preserve variability rather than reduce it to central tendencies. This is the key for capturing individual differences and relational factors in naturalistic clinical trials and individualized treatment, where each patient's experience and each patient-therapist pair are seen as unique, rather than an all too prevalent focus on generic syndromes with generic treatments in a generic, manualized way. In clinical trials, the demand for evidence-based practices often translates into manualized therapy trials, where the very absence of a spontaneous relationship between therapist and patient, as is found in more naturalistic settings, severely limits the very ingredient of a healing relationship.

Historically, regularity and stability have been considered the hallmarks of mental and physical health. Because standardized psychological tests, such as WAIS and MMPI employ linear statistics, their flat normative lines have been used to rule out the absence of psychopathology. While useful in many ways, such measures can also be used to stereotype people while offering illusory constructs out of accord with their individual and cultural dynamics. For example, intelligence tests are now known to be culturally biased in favor of Caucasians (Manly et al. 1998). A complexity perspective suggests that regularity and stability are themselves emergent functions against the background of underlying chaotic irregularity. Optimal health is thus defined by *a balance between variability* (chaotic fluctuations in just about every underlying physiological system, such as heartbeat, motor gait, or neural firing (Goldberger et al. 1990; Kumar, 2012) *and meta-stability* essential for our psychophysiological functioning (Tognoli & Kelso, 2014). In psychological systems, too much variability tends to destabilize the person's self-organization and functional capacity, such as in psychotic and dissociative disorders, while too much regularity can lead to rigid obsessiveness, compulsive re-enactments, and difficulties adapting to novelty and change (Siegel, 2006).

In the field of psychotherapy, John Gottman successfully adapted the nonlinear paradigm of weather modeling to emotional dynamics in couples. Ironically, in focusing on chaotic dynamics of moment-to-moment emotional exchanges, he became quite adept at predicting long-term dynamics, such as whether a couple will remain together after 10 years (Gottman et

al. 2005). Within psychoanalysis, Robert Stolorow (1997) introduced the model of "dynamic, dyadic, intersubjective systems" in his conceptualization of therapeutic interaction. The notion of intersubjectivity suggests the impossibility of absolute objectivity within therapeutic endeavor. Whereas Freud's classical approach was a one-person, intrapsychic view of the treatment process (therapist as an objective observer of the patient's psychopathology), contemporary relational models offer a *two-person perspective*, wherein therapists inevitably become *participant observers* of the patient's experience and impact his or her self-system in the process of interacting with it. Advanced neuroimaging techniques, such as functional near-infrared spectroscopy (fNIRS) now allow for simultaneous measurements in two or more brains in naturalistic contexts, enabling meta-reductive two-person perspectives (Valencia & Froese, 2020).

Nonlinear dynamics in complex adaptive systems has been postulated as a meta-framework in both individual (Spruiell, 1993; Lyons-Ruth, et al. 2001; Marks-Tarlow, 2013, 2014b; Seligman, 2005; Shapiro, 2015) and group psychotherapy (Grossmark, 2007), with the emergence of Dynamical Systems Therapy (DST) as a conceptual foundation for both psychotherapeutic and psychopharmacological approaches (Shapiro, 2014, 2015; Shapiro & Scott, 2018). These models involve informational dynamics at the interpenetrating intersubjective boundaries between two (or more) individual subjectivities in the treatment setting, as well as at the *interobjective* interface between individuals and objective reality at large (Marks-Tarlow, 2013; Marks-Tarlow et al. 2020; Marks-Tarlow & Shapiro, 2021 – see Figure 1).

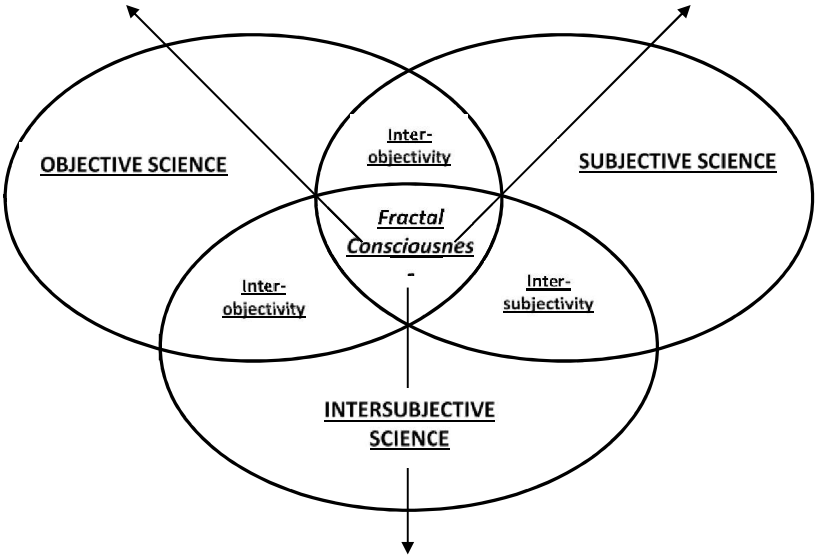

Figure 1. Illustration of intersubjective and interobjective interfaces that define fractal consciousness at the intersection of objective, subjective, and intersubjective domains.

From the informational complexity perspective, the seeming duality of brain/mind dissolves into an artefact of the reductionist approach. Both the *res extensa* of matter/brain and *res cogitans* of consciousness/mind are seen as naturalistic informational processes that operate with self-similar patterns within multiple domains, from cognitive, affective, social, and

cultural neuroscience, to subjective patterns of self-identity and meaning, to intersubjective patterns of relating, to interobjective patterns of interacting with our environment. Such self-similar processes are described by the construct of *fractal consciousness* that captures complex natural processes previously inaccessible for a more holistic approach to scientific modeling and consciousness studies.

A Fractal Epistemology for a Scientific Psychology

Epistemology, or the study of how we know what we know, involves both explicit knowledge and unconscious assumptions about the universe and its workings. These assumptions not only guide the questions that shape scientific research but also the self-referential processes of how we conceive the workings of our own conscious and unconscious processes. In this chapter, we introduce a conceptual clinical framework based on principles derived from fractal geometry. From its discovery/invention by a French mathematician, Benoît Mandelbrot (1982), this branch of mathematics has been used to model processes considered to be too irregular, discontinuous, or complex for traditional methods. Whereas Mandelbrot focused on fractal patterns in the natural world, such as coastlines, cloud shapes, and river meanderings, he understood fractals as a "new geometric language" with the power to unify science and art, reason and intuition. In his words, "mathematics gains by not attempting to destroy the 'organic' unity that appears to exist between seemingly disparate but equally worthy activities of Man, the abstract and the intuitive" (1989, p. 9). We now know that the informational language of fractal geometry is just as applicable to complex internal patterns of human physiology (the branching of blood vessels or architecture of synaptic networks) and to patterns of self-experience, our relationships with others, and our interactions with the environment at large (Marks-Tarlow, 1999, 2012b; Marks-Tarlow et al. 2020).

Fractal dynamics are based on the principles of *self-similarity* and *scale invariance*, where the pattern of the whole recursively repeats within the patterns of the parts at different spatial and/or temporal scales (see Figure 2). One can readily conceive of personality in fractal terms. An aggressively competitive person might interrupt others at the micro-scale of conversation, cut others off when driving on the highway, and push colleagues aside within the broader time scale required for forging a career. In this example, self-similar relational dynamics are manifesting from short- to longer-term temporal scales across different situational contexts. Another example would involve repetition-compulsion scenarios, such as a person who rigidly keeps repeating the same pattern of choosing abusive partners again and again. The recursive repetition of pattern is not unlike a Mandelbrot Zoom[4], where computer simulation provides a kind of microscope into self-similar spatial patterns that keep emerging within different size scales. With people, as with the Mandelbrot zoom, there is self-similar repetition of holistic patterns, though the repetition is nonlinear and never exact.

[4] A Mandelbrot zoom refers to a visual exploration of the Mandelbrot set, a set of complex numbers that produces a distinctive, infinitely complex boundary when plotted on the complex number plane, such that the zoom progressively magnifies the boundary of this set to reveal ever more intricate and detailed fractal patterns (See https://www.youtube.com/watch?v=b005iHf8Z3g for an example.)

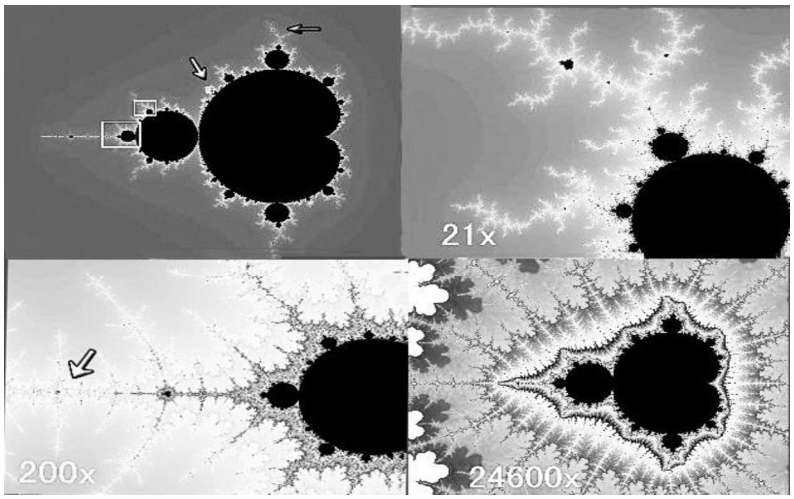

Figure 2. Illustration of Mandelbrot zoom.

Whether in the form of the information encoded in genes, human narratives at the basis of various cultures, or the repetition of habits over time at the individual level, *recursion* lies at the very heart of life as we know it. Alongside branching patterns in the lungs and blood vessels, processes of embryological development, social networks, and evolution as a whole, recursive dynamics are at the root of building ever greater neural complexity evident in the structure and function of the brain. Repeated iteration of recursive algorithms, such as re-entrant loops of synaptic activity, has been linked to diverse psychological phenomena, from perception binding to conscious experience and self-awareness (Edelman, 2004). Consider the simple process of self-reflection, which necessitates self-similar iterations of a psyche capable of observing and remembering itself. The very discipline of psychology is defined by a formalized and recursive turn of the mind back on itself. From this perspective, the level of complexity inherent in psychology necessitates a meta-reductive epistemology capable of capturing fractal patterning.

The cardinal advantage of a fractal epistemology is its ability to hold ambiguity, paradox, and observer dependence within a framework much closer to the recursive dynamics of the lived subjective experience within the complex adaptive system of brain/mind/body, as opposed to disembodied assumptions of classical reductionist science. One critical difference involves the concept of *inter-dimensionality*, where the definition of a boundary shifts from a linear construct separating the whole into clearly defined parts—to infinitely deep border regions that *both separate and unite the domains in question*. Because fractals arise in the infinite spaces between ordinary Euclidean dimensions, they can help us to-re-define boundary conditions as *both separating and bridging zones* (Figure 3), integrating the seemingly disparate processes into a systemic whole (consider a cell membrane, which both defines the boundary of the cell's inner space and unifies it its outer physiological environment to allow for ongoing homeostasis).

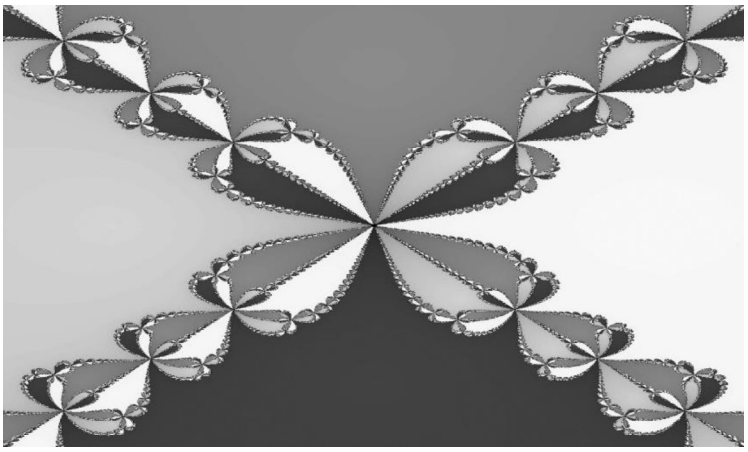

Figure 3. Newton's method of approximation reveals fractal boundary zones between intuitive and correct solutions indicative of veridical external reality. For a quadratic equation, each of the four shaded areas converges toward one of four correct solutions. Whereas each solution is finite, the boundary zones separating each basin of attraction are infinitely deep, revealing infinite interpenetration between the parts and the whole, such that each boundary zone recursively contains the entire pattern.

Psychotherapists who engage in long-term, open-ended work frequently encounter fuzzy psychological boundaries between self and other, especially during emotionally intense periods. The psychoanalytic concept of the *relational unconscious* (Gerson, 2004; Sands, 2010) suggests that an open portal of unconscious exchange may exist between therapist and patient. During psychotherapy, porous boundaries below the threshold of consciousness are frequently reflected in dream content and symbolism. An example, cited in Marks-Tarlow (2024), occurred when a patient brought a dream into therapy reflecting the content of the therapist's recurrent dreams during childhood. By reminding the therapist of her own early vulnerability, the dream broke through the therapist's emotional defenses which allowed the dyad to break through the current treatment impasse.

Fractal boundaries are thus seen as non-binary constructs that allow for interpenetration between distinct but interdependent domains. Examples range from the undulating boundary between conscious and unconscious processes; to interpenetrating individual subjectivities in the process of relating to each other; to the complex interobjective zone between subjective and objective realities that give rise to scientific and artistic achievements, which are simultaneously "created" as part of our subjective exploration and "discovered" in the world "out there." A fractal epistemology also provides an elegant solution to the Nobel mathematician Eugene Wigner's paradox of the "unreasonable effectiveness of mathematics in natural sciences": how it is that random mathematical symbols we scribble on a piece of paper end up describing the very nature of reality "out there"? However, if physical and psychological domains are in fact self-similar, then our mental constructions will inevitably show meaningful correlations with "reality out there." In psychotherapy, such bridging is instrumental in reconciling seemingly contradictory perceptions, feelings, and cognitions inherent in both individual and couple/group treatment, and in negotiating our views of external reality rather than polarizing or disregarding it.

Fractal consciousness (Marks-Tarlow, 2013) is defined as quick and effortless ability to intuitively grasp the self-similar patterns in the world around us and in our relationships with

others, the threads that define the tapestry of our experience. This kind of intuitive knowing—by which we perceive the pattern of the whole from the pattern of the parts—works because we use a recursively operating brain/mind to perceive fractal patterns in other brain/minds and nature at large, of which we are a part. The concept of "thin slicing" introduced in Malcom Gladwell's *Blink* (2006) is a good example. As opposed to slow deliberation of the conscious mind (Kahneman's (2011) analytical "system 2" thinking), the quick assessments of the unconscious mind (system 1) may be possible precisely because our minds share the same recursive, holistic patterning as nature at large. Awareness of fractal self-similarities is particularly valuable in psychodynamic practice, where therapists systematically hone their ability to discern their patient's repeating dysfunctional patterns, both in their life outside and their transference re-enactments in the here-and-now of the therapeutic milieu (Marks-Tarlow, 2014a; Shapiro, 2014).

A fractal epistemology complements clinical science in going beyond the analysis of constituent parts, such as the patient's diagnosis and symptomatic presentation, also incorporating the interpenetrations of parts within living, complex adaptive systems of mind/body/brain (see Figure 1). Fractal patterning reveals the collective dynamics of emergent complexity that give rise to novel levels of organization, which make the whole of our patients' life experiences more than the sum of their developmental, cognitive, affective, or interpersonal parts. In so doing, fractal consciousness allows us to transcend the entrenched Cartesian binaries of brain versus mind, objectivity versus subjectivity, conscious versus unconscious, rational versus intuitive, and neuroscience versus psychodynamics. In each case, the seeming binary becomes an opportunity for a meta-reductive exploration of the infinitely deep boundary regions that both separate and unite the concepts in question.

The non-binary nature of the fractal epistemology can also serve as an antidote to polarized thinking increasingly prevalent in today's society, from gender identity to race and religious intolerance; to increasing xenophobia and political stratification on social media; to deep divides on the subjects of climate change or Covid vaccinations. From a fractal perspective, the xenophobic "us versus them" mentality is counterbalanced by the symmetry of equally deep similarities in our nature and perspectives, our very differences often highlighting underlying motivation to adapt to the wider reality and fit in with our social group.

Diagnostically, we might speculate that the boundaries between some, if not all, categorical DSM disorders are also infinitely deep. Attempting to fit the experience of a suffering patient into a narrow box of a DSM syndrome is rarely possible, and comorbidity is a rule in psychiatric diagnosis (Shapiro, 2018). There are as many faces to depression as there are depressed people, and symptomatic presentations often shift during treatment to reveal deeper issues that may have been submerged in the initial assessment. The very concept of personality may be redefined in fractal terms by the self-similar expression and repetition of various traits on different spatial and temporal scales. Within the field of psychology, a fractal epistemology may also help to unify the splits between various theoretical orientations, whose practice so often yields more commonalities than differences at the level of common factors shared by all therapies (Castonguay & Beutler, 2006; Wachtel, this volume).

Fractal Principles in Psychodynamic Psychotherapy

The core issue for any mental health care professional is to establish an adaptive balance between a particular theoretical orientation that informs diagnostic and treatment formulations, and the salient factors of our patients' subjective experience within unique patient/therapist relational dynamics that provide the context for any therapeutic change. Despite the prevalent evidence-based treatment (EBT) approach in clinical psychology today, therapy-specific techniques account for less than 2% of the outcome variance (Duncan & Miller, 2006), the patient's subjective meaning and therapeutic alliance factors largely determining any treatment outcome. As Nancy McWilliams (2013) aptly points out:

> It used to be understood that psychotherapy is a *healing art*. Therapy itself was understood to be a *healing relationship*. Within that relationship, as both parties became more aware of what was needed to help a given person to grow and change, numerous specific techniques might be called for, but the emphasis was on the relationship itself, on therapy as a special kind of relationship. In recent decades, psychotherapy has been slowly and invisibly redefined as a set of techniques to be applied to discrete disorder categories, and therapists have been essentially redefined as authoritative technicians rather than as collaborative healers. (p. 933, italics in the original)

We do not treat disembodied DSM disorders but instead the living, suffering people who have them. The long-term aim of any therapeutic endeavor is not the revolving door of short-term symptom reduction, but *psychological wellness* defined at the level of adaptive attachment, mastery, and meaning in the patient's life (Shapiro, 2018). The following principles of fractal epistemology can guide us toward that goal.

A Fractal Epistemology Focuses Clinical Attention on Self-Similar Patterns That Lie at the Core of Both Psychopathology and Adaptive Functioning

In its widest sense, psychodynamic psychotherapy aims at uncovering and modifying dysfunctional patterns of feeling, thinking, and relating that cause distress and bring the patient to treatment. Such patterns are self-similar in that they manifest in different settings and at different times, yet possess common pathological features, such as a tendency towards anxiety, emotional dysregulation, obsessive rumination, or problem behaviors like self-sabotage or addictions. Patients may feel "drawn" to these cycles because they represent the lowest energy state of their self-system, represented as attractor basins on their unique adaptive landscape (A-landscape – Figure 4).

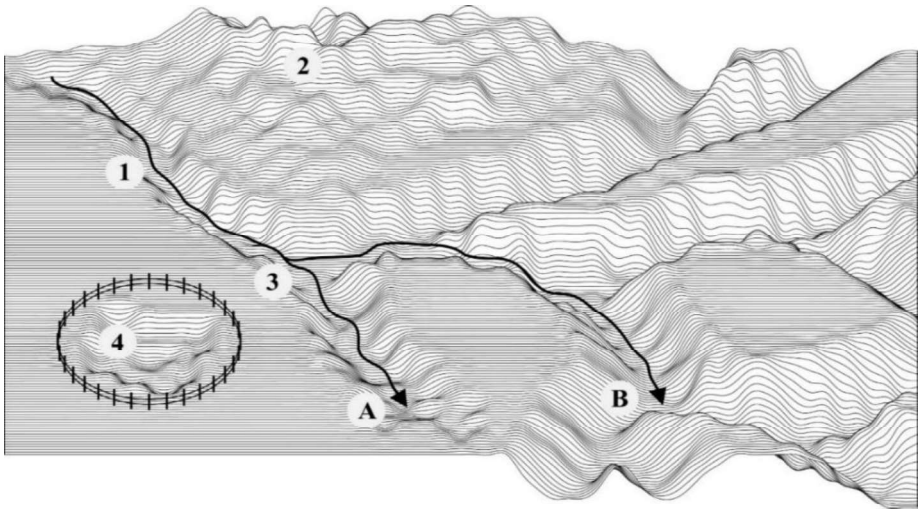

Figure 4. A portion of a complex A-landscape with attractor/repeller sets (adapted with permission from Shapiro & Scott, 2018). 1. An attractor basin that underlies the patient's life trajectory (e.g., heterosexual orientation that leads to selecting opposite sex partners); 2. A set of repellers that a person tends to avoid (e.g., choosing a same-sex partner for a strongly heterosexual person; signing up for parachute jumping for a person with acrophobia); 3. A bifurcation point that qualitatively changes the systemic trajectory (e.g., making a marriage commitment for a person with a history of brief superficial relationships); 4. A "fenced off" attractor basin (e.g., treating gambling addiction by staying away from VLTs); A/B. Potential trajectory outcomes (e.g., a superficial involvement that peters off versus a committed relationship).

Both subjective patterns of perception, feeling, and thinking, and objective patterns of observable behavior and relatedness can be mapped on one's A-landscape, where plotted over time, pathological self-similar patterns are represented by the attractor ruts, where the patient's habitual behaviors routinely flow (Shapiro 2015; Shapiro & Scott, 2018). For instance, they may represent a pattern of choosing abusive relationships that, if left unattended, may continue and get further entrenched (point A), while in the context of successful therapy, it may peter off and be replaced by healthier relational choices (point B). The qualitative change from one attractor basin to another (point 3) is referred to as *bifurcation*, which allow the patient a choice of future action.

A-landscapes can serve as a "map of the mind" in the therapeutic process, where we can visually represent both pathological attractor and *repellor* configurations (potentially healthy behaviors that the patient tends to avoid). They illustrate meta-reductive bottom-up/top-down bi-directional causality, where existing templates guide our habitual choices, while our choices ultimately re-shape the established templates (think of a mountainous landscape that guides the flow of a water stream, while it is the stream itself that carves out a canyon over time). Our choices are thus influenced both by our hardwired Darwinian algorithms acquired during our species distal phylogeny (such as instinctive fear of spiders and the dark, or propensity for novelty seeking versus harm avoidance)—and *proximal adaptations* in the course of our individual development (such as experiences of early trauma resulting in a negative self-concept, inability to trust others, and maladaptive re-enactments in adult life).

Yet, our capacity for ongoing learning and adaptation constantly re-shapes our A-landscape over time and underlies common therapeutic processes, such as working through transference

distortions, exposure techniques, or memory reconsolidation (Lane et al., 2015; Wachtel, this volume). All A-landscapes are flexible *psychobiological constructs* modified by learning; in turn, psychotherapy is a form of psychobiological learning, the point stressed by Eric Kandel (1998): "Insofar as our words produce changes in our patient's mind, it is likely that these psychotherapeutic interventions produce changes in the patient's brain. From this perspective, the biological and sociopsychological approaches are joined" (p. 466).

A Fractal Epistemology Operates with Fuzzy Boundaries That Allow Interpenetration of Seemingly Separate Domains

Within clinical practice, the concept of psychological boundaries has been central yet difficult to define precisely. Whether referring to healthy boundaries between therapist and client; sexual boundaries between partners; emotional boundaries between friends or family members; or intrapsychic boundaries between conscious and unconscious experience—the concept often implies clear separation between the phenomena involved. Yet, psychological boundaries are inherently fuzzy, partly because so many boundary zones in nature are fractal, involving complex processes of nonlinear interchange, such as interpenetration within neural networks in the brain; communication between partners or social groups; or insight in bringing maladaptive patterns into the patient's awareness in the course of psychotherapy.

Consider the nonlinear concept of *multistability* in the brain, which is central to its operation in real time. Multistability means that the boundaries between active cell assemblies, or groups of synchronized neurons are continuously forming and reforming in the process of our inner information processing and interaction with the environment (Cozolino, 2017). The open wiring of the human brain requires external input from the physical and social environment to allow for healthy adaptations and stable self-organization. At the same time, the human brain, like all living systems, is organized at the critical edge of chaotic dynamics (Hesse & Gross, 2014), such that no pattern of neuronal firing ever repeats itself precisely, with the boundaries of neuronal activity ever changing. Hyperscanning techniques, which involve simultaneous measurement of two brains engaged in a mutual task, reveal that similar oscillatory dynamics connecting different areas of an individual brain also operate between individuals, correlating the degree of neural synchrony to the experience of connection and cooperation (Valencia & Froese, 2020). Whether between self and the world at large, or self and other, psychological boundaries are always dynamic, ever-shifting zones of negotiation. This results in fluid, ever-shifting dynamics as a central feature of consciousness.

At the level of therapeutic engagement, we rely on both "objective" observational evidence of the patient's verbal and nonverbal behavior, their subjective reports, and the therapist's countertransference/clinical intuition in order to engage with the patient in a meaningful way and help modify the dysfunctional patterns that bring them to treatment. Therapeutic relationship, therefore, necessarily involves interpenetration of the patient's and therapist's A-landscapes, allowing for a degree of external regulation of the patient's traumatic affects before newer and healthier relational templates are fully internalized. This process mirrors the developmental progression from external to internal self-regulation with the primary caregiver (Tronick, 2007).

Fractal Measurement Illuminates Observer Dependence, Whereby What We See Is a Function of How We Look

The relational model revolutionized classical physics with the works of Albert Einstein, who famously showed that the previously fixed categories of space and time are relative to the observer's perspective. The critical importance of observer's measurements became even more apparent in the evolving discipline of Quantum Mechanics, where the very nature of physical properties we observe (such as particle versus wave nature of matter) depends on how the observation is made.

Observer dependence is equally critical in psychiatry and psychotherapy, where what we see depends on how we look and what questions we ask. In the history of psychoanalysis, there has been a shift from a one-person "objective observer" model, where psychopathological processes in the patient's psyche were analyzed by a neutral expert-therapist, to fully relational two-person "participant observer" models of treatment, where the focus of clinical attention shifts to emergent dynamics that self-organize in the transitional space between the participants (Mitchell, 2014; Stolorow, 1997; Summers, 1999). One implication of a fully relational model is that the same patient will respond differently to the same treatment within different relational settings—a paradigm that applies equally in psychopharmacology and psychotherapy outcomes (King & Shapiro, 2022).

The infinite variability of fractal dimensionality captures not only qualitative features of nature, such as the ruggedness of a mountain scape, jaggedness of a shoreline, or fluffiness of the clouds, but also our "internal" and relational landscapes, such as patterns of individual perception, the nuances of emotional experience, the infinite expanses of contemplation and creativity, the experience of consciousness as it leaps from inner to outer worlds, and the paradox of full engagement, such that the closer one looks, the more there is to see (see Figure 2).

In this light, symptom presentation often shifts during the course of treatment, when deeper layers of the patient's personality and psychopathology come to the forefront. By the same token, seemingly rigid DSM diagnostic categories evidence a similar shift, revealing more fluid nature of individual psychopathology than we usually realize. In addition, the same patient may show different response to the same treatment, whether psychotherapeutic or psychopharmacological, depending on who administers it and what the quality of therapeutic interaction may be (Miller, et al. 2015; Mintz, 2022).

A Fractal Epistemology Highlights Idiosyncratic, Unique, and Rare Events by Utilizing Power Law Distributions That Focus on the Outliers Rather Than on Central Tendencies

The established tradition in Western science is to look for stability and central tendencies while de-emphasizing variability and intermediate states. In contrast to normative statistics, power law distributions present an alternative approach wherein variability is preserved while unpredictable, chance events are factored in. This enriches the study of the phenomena in question through the recognition of multiple possibilities, such that the outliers become equally relevant to the central tendency. In psychotherapy, each patient and each therapeutic relationship are unique, notwithstanding the similarity in symptom presentation and evidence-based treatment manuals. We all need to be seen as unique individual rather than generic cogs in a manualized machine. Here is a thought experiment: imagine you are feeling depressed and

decide for the first time in your life that you need to see a psychotherapist or psychiatrist. Would you rather be in the presence of someone whose attitude is: "We need to make a proper diagnosis and treat the symptoms with the available evidence-based algorithms," or someone who tries to understand what the experience of depression is like *for you*, and how to help *you* feel better in your specific circumstances?

Bruce West (2016) illustrates the shift in research focus driven by fractal science as moving from the power in the center to the power in the tails, where the edges and outliers define the process more than the middle of the distribution. For instance, the critical measure for any society is not just its average gross domestic product (GDP) but the distribution of wealth among the people. Social disparity follows a power law distribution, with a tiny and ever decreasing percentage of the population holding the majority of wealth, not only in the United States but across most developing countries in the world. Thus, in the rich nation of USA, according to the 2020 Census Bureau report, some 28 million people, or 8.6 percent of the population, have no access to health care (Keisler-Starkey & Bunch, 2021).

The fictitious nature of focusing on central tendencies alone is particularly harmful in psychiatry and psychotherapy, where we may lose the forest of the patient's experience and relational dynamics for the trees of statistical DSM-based symptoms and manualized tools for their assessment and treatment. As nonlinear measures become more prevalent, research paradigms are better able to capture patterns of variability and uniqueness and enable a clinical shift to individualized medicine as exemplified in Gordon Paul's (1967) challenge: "*What* treatment, by *whom*, is most effective for *this* individual with *that* specific problem, and under which set of circumstances?" (See Shapiro & Scott, this volume).

A Fractal Epistemology Captures Paradoxical Insights Related to Clinical Intuition And Uncanny Knowing, Including the Ability to Hold Ambiguity, Paradox, and Uncertainty

One of the most difficult experiences for human beings is tolerating ambiguity and uncertainty about the future. Within development, the extreme example of this is disorganized attachment, wherein the primary caregiver's responses to the child are too unpredictable to allow for stable self-development. The human brain, self-system and social networks are fundamentally nonlinear, and their trajectories cannot be predicted with any degree of certainty, as our experience with weather systems, stock markets, and social changes illustrates. At the subjective level, we deal with uncertainty all the time, and our inability or unwillingness to tolerate it gives rise to multiple forms of psychopathology, such as neurotic-spectrum anxiety disorders; existential helplessness and fear of death; or preoccupations with power and control. Meanwhile, the apocryphal 12-step serenity prayer ("God, grant me the serenity to accept the things I cannot change, courage to change the things I can, and wisdom to know the difference") is also an acknowledgment of the limits of certainty and control, even over ourselves.

Understanding anxiety is central to the psychoanalytic endeavour (see Wachtel, this volume). From the fractal perspective, we can understand anxiety as difficulty accepting limits to certainty, mentally compensating by trying to "figure it out," which results in endless cognitive loops and obsessional dynamics. A fractal epistemology can model ever-shifting modes of consciousness, from its ordinary to altered modes, which range from neurotic and dissociative states in psychopathology, to meditative and flow states, to lucid dreaming and

oceanic feelings of interconnection with everything that exists, to shamanic and nondual states of consciousness, where our sense of self-identity may be altered or lost (Flor-Henry, et al. 2017). Fractal consciousness bridges explicit rational thought characterized by serial information processing, with intuitive awareness that captures the gestalt of the phenomena in question. These complementary modes of knowing best operate in tandem, such as in psychotherapy, where analytical and intuitive knowing complement each other in the service of helping our patients (Marks-Tarlow, 2012a, 2014; Shapiro & Marks-Tarlow, 2021).

A fractal perspective allows us to translate some of the key psychodynamic principles into a meta-reductive informational language. For instance, transference-countertransference dynamics can be seen as a fractal microcosm of recursively enfolded, self-similar exchanges between patient (transference) and therapist (countertransference). At times, these repetitive dynamics reflect projections of early childhood relationships onto the other. At other times, the dynamics are more reflective of here-and-now current emotional responses. Italian analyst Biraschi (2022) was able to quantify the complexity of the psychological interview by dividing verbatim transcripts into Relational Verbal Units (RVU) whose sizes were determined by the number of words composing the verbal exchanges during turn taking. A size/frequency graph revealed a fractal pattern of power law distributions (fractal patterns in time), with the typical Relational Fractal Dimension (RFD) for each dyad ranging between 1.39 and 1.5, a range indicative of self-organized criticality.

Along with quantifying qualitative exchanges, a fractal perspective is especially useful for conceptualizing the psychoanalytic concept of *projective identification*, the idea that dissociated or disowned aspects of the patient that exist beneath conscious awareness sometimes can be experienced by therapists as if their own experiences. Within a traditional reductionist paradigm this notion was controversial because it implied that patients were 'injecting something' into therapists, which seemed preposterous. From within a fractal perspective of fluid boundaries, we can understand projective identification as unconscious resonance leading to information sharing in the relational unconscious such that therapists are able to perceive what is blocked to patients by their own defenses.

The aforementioned principles of fractal epistemology can serve as powerful meta-reductive tools that can help to address rigid and maladaptive aspects of psychopathology as well as the worsening splits between clinical research and psychotherapy practice, and between various schools of therapy, such as cognitive-behavioral versus psychodynamic approaches. They enable the clinical shift from reductionist "evidence-based practice" to meta-reductive *evidence-based principles of care*, which include common factors of attending to the patient's unique experiential systems of meaning and dynamics of the patient-therapist relationship (Castonguay & Beutler, 2006; Shapiro & Scott (this volume). The key concept of meta-reductive science is that ours is not a black-and-white world of binary yes/no answers but a rich tapestry of interwoven and ever evolving objective, subjective, and intersubjective realities, where the answers to the questions we seek depend on the ways in which we ask them.

Clinical Vignette

To understand fractal consciousness within psychotherapy, the most obvious examples involve cases where clinicians may perceive the whole of the patient's predicament from the very first

moment of meeting. Levenson's (1976) psychoanalytic approach captures this idea. Even before fractals were discovered, much less popularized, he asserted that the whole of any analysand's treatment is evident from the course of the first session, and recursively, the whole of each session is also evident from the nature of the first interchange during each clinical hour.

One can also detect fractal consciousness within the opening passages of Malcolm Gladwell's book, *Blink*, where he describes the capacity of couple's researcher John Gottman to highly accurately predict whether a couple will remain together ten years from now based solely on the quality of a 5-minute interaction discussing a challenging issue. Rather than attending to the content of the couple's exchanges, Gottman attunes to the quality of their nonverbal interactions. As they discuss their most painful or stuck places, does this couple remain open and connected to one another with supportive gestures, or do they close off their bodies, evidence scowls, roll their eyes, or otherwise indicate contempt or judgment for one another?

Levenson's and Gottman's examples highlight the importance of fractal consciousness within clinical interactions, whereby clinicians may intuitively grasp the whole picture from thin slices of experience. What may be less obvious is the importance of fractal consciousness within patients. Yet, the restoration of trust in one's own sensibilities and intuitive awareness is key to mental health. For example, to accurately sense and attend to danger signals in the first moments of a dating relationship can save much heartache later. Intuition is a key ingredient to anyone needing to respond in the face of ambiguity, uncertainty, incomplete or too much information (Marks-Tarlow, 2013). Because our social lives are ripe with these conditions, we chose a clinical example involving fractal consciousness on the part of the patient rather than the clinician.

One of us (M-T) has been working with Rose for about two years following her decision to return to psychotherapy. Rose is also a psychotherapist, a bit older though newer to the field. She had reached a point of feeling somewhat shut down, which she described as feeling 'dead inside'. Other than her husband, she had become isolated during the pandemic and felt she had lost the ability to relate to others in a loving way that she so prided herself in. Rose was attracted to working with me because of my specialty in creativity and intuition, both of which she craved to experience in life.

I see Rose on a weekly basis. During the session I'd like to highlight, I experienced myself as fully engaged. Yet somewhere in the middle of the clinical hour, Rose announced, "I feel distracted ... by you!"

"What do you mean?" – I responded.

"You look tired. You don't seem present."

At first, I protested. We revisited similar exchanges—Rose kept insisting something was going on with me; I kept denying this was so. Because I was caught up in the content of our discussion, I initially responded in a rather defensive way.

Eventually, I took a moment to pause and self-reflect. After getting past my own automaticity, I realized that Rose was right. I had not slept well the night before. In fact, I had barely slept at all. My husband and I had had an exceedingly rare tiff with one another during dinner the previous day. I had spent the entire night fearing that we were drifting irreversibly apart from one another. I then woke up to realize I had a full clinical day in front of me and needed to put all my personal issues aside if I was to be effective.

Rose exhibited fractal consciousness by being able to see the whole picture of me being preoccupied with dealing with my own unresolved content. From the beginning of our work

together, she was highly sensitive to nuances in my face, posture, and countenance. In the past, if she perceived me as less than fully engaged, she automatically owned it and expressed her fear of 'boring' me. During this particular session, Rose's ability to assume the problem was in me and not in her was a huge leap in treatment. My willingness to let Rose know more about me than I recognized about myself was humbling yet not humiliating, as this is the essence of fully relational psychoanalytic treatment. Both therapist and patient have the opportunity to engage in a "real relationship" way, flaws and all, with one another. After a childhood filled with being silenced, primarily by her father, Rose's ability to risk both speaking out and sticking to her intuition despite my repeated protests was a remarkable moment of meeting that left us both feeling proud.

Conclusion: Fractal Consciousness as an Integrative Foundation for Psychotherapy and Clinical Research

Reductionist science traditionally sought to resolve paradox and converge to a single conclusion, and yet the fundamental nature of the natural world is to allow a range of possibilities at multiple levels of observation. This is evident at the quantum level, where multiple potentialities co-exist until an observation is made (Schlosshauer, 2005); in formal logic and mathematics, where Kurt Godel's incompleteness theorems show that no sufficiently complex system can be both complete and self-consistent at the same time (Reichenberger, 2019); and in evolution, where co-evolving organisms converge and diverge over time, shifting between periods of gradual quantitative change and qualitative jumps to novel levels of systemic organization, known as *punctuated equilibria* (Gould & Eldredge, 1993). In psychology, co-existence of opposing and contradictory feelings and impulses, and our tendency to rationalize them are ubiquitous, and fractal dynamics help us to hold multiple potentialities in our awareness, allowing for healthier adaptations to our environment and social milieu.

Throughout its relatively short existence, psychology has been struggling to establish itself as a scientific discipline, which often translated into seeking objectivity in its research and academic goals. The prevalent reductionist stance greatly limits our ability to work with brain/body/mind as a complex adaptive system, including its emergent conscious and unconscious dynamics. It also contributes to the proliferation of mechanistic approaches to psychopathology and its treatment, with manualized assessments and treatment algorithms that often focus on symptomatic management of rigidly defined DSM categories rather than the emergent dynamics of the patient's experience and therapeutic alliance. As a counterreaction, practitioners of clinical psychology and psychoanalysis have often eschewed science altogether in attempts to be freed from overly linear and restrictive "evidence-based" algorithms. These deep internal divisions have partly been fueled by outdated concepts, such as mechanistic steam engine or computer models of psychopathology that represent gross oversimplifications of how nature actually works.

By adopting a fractal epistemology, we can incorporate the full complexity of the patient's lived experience, with its underlying unconscious elements, and the shifting dynamics of the therapeutic interaction into clinical work while relying on a universal informational language that applies as readily to the objective scientific phenomena as it does to subjective and

intersubjective experience. Fractal consciousness offers a holistic mode of understanding that allows clinicians direct access to central psychological patterns within the nested hierarchies on temporal and spatial scales that span the full range of existence, from physiological levels within the brain to psychological, social, and cultural levels of self-organizing emergent dynamics. Attention to fractal consciousness offers researchers and clinicians the unprecedented opportunity to establish a trans-theoretical foundation for diverse schools of thought in order to bridge cognitive, experiential and psychodynamic approaches, psychotherapy and psychopharmacology, mind and brain, and clinical research with clinical practice in the service of our patients.

Disclaimer

None.

References

Aftanas, I., Lotova, N. V., Koshkarov, V. I., Makhnev, V. P., Mordvintsev, Y. N., Popov, S. A. (1998). Non-linear dynamic complexity of the human EEG during evoked emotions. *International journal of psychophysiology*, *28*(1):63-76. http://doi.org/10.1016/s0167-8760(97)00067-6.

Bak, P. (2013). *How nature works: The science of self-organized criticality*. New York, NY: Springer-Verlag.

Biraschi, J. (2022). Relational fractal fimension: From the complexity of psychological interview to the emergence of the therapeutic telationship. *Nonlinear dynamics, Psychology, and Life Sciences*, *26*(1):81-104.

Beauregard, M. (2007). Mind does really matter: Evidence from neuroimaging studies of emotional regulation, psychotherapy, and placebo effect. *Progress in Neurobiology, 81*(4):218–236.

Buzsaki, G. (2006). *Rhythms of the Brain*. Oxford, UK: Oxford University Press.

Castonguay, L. G., Beutler, L. E. (2006). Principles of therapeutic change: A task force on participants, relationships, and techniques factors. *Journal of Clinical Psychology, 62*(6):631–638. http://doi.org/10.1002/jclp.20256.

Cozolino, L. (2017). The *Neuroscience of psychotherapy: Building and rebuilding the human brain* (3rd ed). New York, NY: W.W. Norton.

Damasio, A. (2008). *Descartes' error: Emotion, reason and the human brain*. New York, NY: Random House.

Duncan, B. L., and Miller, S. D. (2006). Treatment manuals do not improve outcomes. In J. C. Norcross, L. E. Beutler, & R. F. Levant (Eds.), *Evidence-based Practices in Mental Health* (pp. 140-149). Washington, DC: American Psychiatric Publishing.

Edelman, G. (2004). *Wider than the sky: The phenomenal gift of consciousness*. New Haven, CT: Yale University Press.

Feldman D. (2019). *Chaos and Dynamical Systems*. Princeton, NJ: Princeton University Press.

Flor-Henry, P., Shapiro, Y, and Sombrun, C. (2017). Brain changes during a shamanic trance: Altered modes of consciousness, hemispheric laterality, and systemic psychobiology. *Cogent Psychology, 4*(1):1313522. http://doi.org/10.1080/23311908.2017.1313522.

Freud, S., and Breuer J. (2004/1895). *Studies on hysteria*. London, UK: Hogarth.

Gangopadhyay, N., and Schilbach, L. (2012). Seeing minds: a neurophilosophical investigation of the role of perception-action coupling in social perception. *Social neuroscience*, *7*(4):410-423. http://doi.org/10.1080/17470919.2011.633754.

Gerson, S. (2004). The relational unconscious: A core element of intersubjectivity, thirdness, and clinical process. *Psychoanalytic Quarterly*, *73*(1): 63–98. https://doi.org/10.1002/j.2167-4086.2004.tb00153.x.

Gladwell, M. (2006). *Blink: The power of thinking without thinking*. Mew York, NY: Little Brown & Company.

Gleick, J. (2011). *Chaos: Making a new science.* New York, NY: Penguin Books.

Goldberger, A. L., Rigney, D. R., and West, B. J. (1990). Chaos and fractals in human physiology. *Scientific American*, *262*(2):42-49. http://doi.org/10.1038/scientificamerican0290-42

Gottman, J. M., Murray, J. D., Swanson, C. C., Tyson, R., and Swanson, K. R. (2005). *The mathematics of marriage: Dynamic nonlinear models*. Cambridge, MA: MIT Press.

Gould, S. J., and Eldredge, N. (1993). Punctuated equilibrium comes of age. *Nature*, *366*:223–227. http://doi.org/10.1038/366223a0.

Grossmark, R. (2007). The edge of chaos: Enactment, disruption, and emergence in group psychotherapy. *Psychoanalytic Dialogues*, *17*:479–499. http://doi.org/10.1080/10481880701487193.

Hesse, J., and Gross, T. (2014). Self-organized criticality as a fundamental property of neural systems. *Frontiers in systems neuroscience, 8*:166. http//doi.org/10.3389/fnsys.2014.00166.

James, W. (2007/1863). *The principles of psychology, vol. I.* New York, NY: Holt.

Jirsa, V. K., and Kelso, S. (Eds.) (2004). *Coordination dynamics: Issues and trends*. Dordrecht, NL: Springer Science & Business Media.

Kahneman, D. (2011). *Thinking, fast and slow*. New York, NY: Farrar, Strauss and Giroux.

Keisler-Starkey, K., and Bunch, L. N. (2021). *U.S. Census Bureau Current Population Reports, P60-274, Health Insurance Coverage in the United States: 2020.* Washington, DC: U.S. Government Publishing Office.

King, I, and Shapiro, Y. (2022). Learning the "science of the art of prescribing": From evidence-based algorithms to individualized medicine in psychiatric care. *Journal of Psychiatric Practice, 28*(5):409-420. doi: 10.1097/PRA.0000000000000651.

Kinreich, S., Djalovski, A., Kraus, L., Louzoun, Y., and Feldman, R. (2017). Brain-to-brain synchrony during naturalistic social interactions. *Scientific reports*, *7*(1), 1-12. http://doi.org/10.1038/s41598-017-17339-5.

Kumar, A. (2012). Chaos theory: Impact on and applications in medicine. *Journal of Health and Allied Sciences NU*, *2*(4):93-99. http://doi.org/10.1055/s-0040-1703623.

Lane, R. D., Ryan, L., Nadel, L., and Greenberg, L. (2015). Memory reconsolidation, emotional arousal, and the process of change in psychotherapy: New insights from brain science. *Behavioral and Brain Sciences, 38*:1-64. http://doi.org/10.1017/S0140525X14000041

Laughlin, R. B. (2005). *A different universe*. New York, NY: Basic Books.

Levenson, E. (1976). A holographic model of psychoanalytic change. *Contemporary Psychoanalysis*, *12*:1-20.

Lin, Y., Leibrandt, D. R., Leibfried, D., and Chou, C. W. (2020). Quantum entanglement between an atom and a molecule. *Nature*, *581*(7808):273-277. http://doi.org/10.1038/s41586-020-2257-1.

Lorenz, E. (2000). The butterfly effect. *World Scientific Series on Nonlinear Science Series A*, *39*:91-94. http://doi.org/10.1142/9789812386472_0007.

Lyons-Ruth, K. and Boston Change Process Study Group. (2001). The emergence of new experiences: Relational improvisation, recognition process, and non-linear change in psychoanalytic theory. *Psychologist-Psychoanalyst*, *21*:13–17.

Mandelbrot, B. (1982). *The fractal geometry of nature* (vol. 1). New York, NY: WH Freeman.

Mandelbrot, B. (1989). Fractal geometry: What is it, and what does it do? *Proceedings of the Royal Society of London A, 423*:3-16. http://doi.org/10.1098/rspa.1989.0038.

Mandler, G. (2011). *A history of modern experimental psychology: From James and Wundt to cognitive science*. Cambridge, MA: MIT Press.

Manly, J. J., Jacobs, D. M., Sano, M., Bell, K., Merchant, C. A., Small, S. A., and Stern, Y. (1998). Cognitive test performance among nondemented elderly African Americans and whites. *Neurology*, *50*(5):1238-1245. http://doi.org/10.1212/WNL.50.5.1238.

Marks-Tarlow, T. (2024). Dreams, synchrony, and synchronicity. *International Journal of Transpersonal Studies Advance Publication Archive*, *86*. https://digitalcommons.ciis.edu/advance-archive/86.

Marks-Tarlow, T. (2014a). *Awakening clinical intuition: An experiential workbook for psychotherapists.* New York, NY: W. W. Norton.

Marks-Tarlow, T. (2014b). The fractal geometry of human nature. In R. Robertson & A. Combs (Eds.), *Chaos theory in psychology and the life sciences* (pp. 275-283). East Sussex, UK: Psychology Press.

Marks-Tarlow, T. (2013). *Psyche's veil: Psychotherapy, fractals and complexity*. New York, NY: Routledge.

Marks-Tarlow, T. (2012a). *Clinical intuition in psychotherapy: The neurobiology of embodied response*. New York, NY: W. W. Norton.

Marks-Tarlow, T. (2012b). Fractal geometry as a bridge between realms. In F. Orsucci & N. Sala (Eds.), On the borders of complexity (pp. 25–43). Hauppauge, NY: Nova Science.

Marks-Tarlow, T. (2004). Semiotic seams: Fractal dynamics of re-entry. *Cybernetics & Human Knowing*, *11*(1):49-62.

Marks-Tarlow, T. (2003). The certainty of uncertainty. *Psychological Perspectives*, *45*(1):118-130.

Marks-Tarlow, T. (1999). The self as a dynamical system. *Nonlinear dynamics, psychology, and life sciences*, *3*(4):311-345. http://doi.org/10.1023/A:1021958829905.

Marks-Tarlow, T., and Shapiro, Y. (2021). Synchronicity, acausal connection, and the fractal dynamics of clinical practice. *Psychoanalytic Dialogues*, *31*(4):468-486. http://doi.org/10.1080/10481885.2021.1925283.

Marks-Tarlow, T., Shapiro, Y., Friedman, H., and Wolf, K. P. (Eds.) (2020). *A fractal epistemology for a scientific psychology: Bridging the personal with the transpersonal*. Newcastle upon Tyne, UK: Cambridge Scholars Publishing.

McWilliams, N. (2013). Psychoanalysis and research: Some reflections and opinions. *The Psychoanalytic Review, 100*(6):919–945. http://doi.org/10.1521/prev.2013.100.6.919.

Miller, S. D., Hubble, M. A., Chow, D., and Seidel, J. (2015). Beyond measures and monitoring: Realizing the potential of feedback-informed treatment. *Psychotherapy, 52*(4):449 – 457

Mintz, D. (2022). *Psychodynamic Psychopharmacology: Caring for the Treatment-Resistant Patient*. Washington, DC: American Psychiatric Association Publishing.

Mitchell, S. (2014). A. *Influence and autonomy in psychoanalysis*. New York, NY: Routledge.

Paul, G. L. (1967). Strategy of outcome research in psychotherapy. *Journal of Consulting Psychology, 31*:109-118.

Peletier, M. A., Van Santen, R. A., and Steur, E. (Eds.). (2019). *Complexity science: an introduction*. Singapore: World Scientific.

Reichenberger A. (2019). From solvability to formal decidability: Revisiting Hilbert's "Non-Ignoramibus." *Journal of Humanistic Mathematics*, *9*(1):49-80. http://doi.org/10.5642/jhummath.201901.05.

Sands, S. H. (2010). On the royal road together: The analytic function of dreams in activating dissociative unconscious communication. *Psychoanalytic Dialogues*, *20*(4):357–373.

Schlosshauer, M. (2005). "Decoherence, the measurement problem, and interpretations of quantum mechanics". *Reviews of Modern Physics*, *76*(4):1267–1305.

Seligman, S. (2005). Dynamic systems theories as a metaframework for psychoanalysis. *Psychoanalytic Dialogues*, *15*:285–319. http://doi.org/10.1080/10481881509348832.

Shapiro, Y. (2014). Psychodynamic formulation in the age of neuroscience: A dynamical systems model. *Psychoanalytic Dialogues*, *24*:75–192. http://doi.org/10.1080/10481885.2014.893777.

Shapiro, Y. (2018). Psychodynamic psychiatry in the 21st century: Constructing a comprehensive science of experience. *Psychodynamic Psychiatry, 46*(1):49–79. http://doi.org/10.1521/pdps.2018.46.1.49.

Shapiro, Y. (2015). Dynamical Systems Therapy (DST): Theory and practical applications. *Psychoanalytic Dialogues, 25*(1):83–107. http://doi.org/10.1080/10481885.2015.991245.

Shapiro, Y., and Marks-Tarlow, T. (2021). Varieties of clinical intuition: Implicit, explicit, and nonlocal neurodynamics. *Psychoanalytic Dialogues*, *31*(3):262–281. http://doi.org/10.1080/10481885.2021.

Shapiro, Y., and Scott, J. R. (2018). Dynamical Systems Therapy (DST): Complex adaptive systems in psychiatry and psychotherapy. In: E. Mittleton-Kelly, A. Paraskevas, & C. Day (Eds.), *Handbook of research methods in complexity science: Theory and application.* (pp. 567–590). Cheltenham, UK: Edward Elgar Publishing LTD.

Siegel, D. (2006). An interpersonal neurobiology approach to psychotherapy: Awareness, mirror neurons, and neural plasticity in the development of well-being. *Psychiatric Annals*, *36*:248–256. http://doi.org/10.1111/papt.12228.

Spruiell, V. (1993). Deterministic chaos and the sciences of complexity: Psychoanalysis in the midst of a general scientific revolution. *Journal of American Psychoanalytic Association*, *41*:3–44. http://doi.org/10.1177/000306519304100101.

Steele, R. S. (1979). Psychoanalysis and hermeneutics. *International Review of Psycho-Analysis*, *6*:389-411.

Stolorow, R. D. (1997). Dynamic, dyadic, intersubjective systems: An evolving paradigm for psychoanalysis. *Psychoanalytic Psychology*, *14*(3):337–346. http://doi.org/10.1037/h0079729.

Summers, F. (1999). Psychoanalytic boundaries and transitional space. *Psychoanalytic Psychology, 16*(1):3–20. https://doi.org/10.1037/0736-9735.16.1.3.

Thelen, E. (2005). Dynamic systems theory and the complexity of change. *Psychoanalytic Dialogues*, *15*:255–283. http://doi.org/10.1080/10481881509348831.

Thelen, E., and Smith, L. B. (1994). *A dynamic systems approach to the development of cognition and action*. Cambridge, MA: MIT press.

Tognoli, E., and Kelso, J. S. (2014). The metastable brain. *Neuron*, *81*(1):35-48. http://doi.org/10.1016/j.neuron.2013.12.022.

Tronick, E. (2007). *The neurobehavioral and social-emotional development of infants and children*. New York, NY: W. W. Norton.

Valencia, A. L, and Froese, T. (2020). What binds us? Inter-brain neural synchronization and its implications for theories of human consciousness. *Neuroscience of Consciousness, 6*(1):1-12. http://doi.org/10.1093/nc/niaa010.

van der Kolk, B., and van der Hart, O. (1989). Pierre Janet and the breakdown of adaptation in psychological trauma. *American Journal of Psychiatry, 146*(12):1530-1540. http://doi.org/10.1176/ajp.146.12.1530.

Varela, F. J., Rosch, E., and Thompson, E. (1992). *The embodied mind: Cognitive science and human experience*. Cambridge, MA: MIT Press.

Vernon, J. L. (2017). Understanding the butterfly effect. *American Scientist*, *105*(3):130. http://doi.org/10.1511/2017.105.3.130.

Waldrop, M. M. (1993). *Complexity: The emerging science at the edge of order and chaos*. New York, NY: Simon and Schuster.

West, B. J. (2016). *Simplifying complexity: Life is uncertain, unfair and unequal*. Al Sharjah, AE: Bentham Science Publishers.

Author's Biographies

Terry Marks-Tarlow, PhD

Dr. Marks-Tarlow is a clinical psychologist in private practice in Santa Monica, California with a specialty in deep transformation and creative blocks. She has authored and edited multiple books and chapters on topics of creativity, clinical intuition, interpersonal neurobiology, nonlinear dynamics and fractal geometry, including *A Fractal Epistemology for a Scientific Psychology* in 2020. She is adjunct professor at Pacifica Graduate Institute in Santa Barbara, California and at California Institute of Integral Studies in San Francisco, California.

Yakov Shapiro, MD

Dr. Shapiro is a clinical professor and psychotherapy supervisor, Department of Psychiatry, University of Alberta, Edmonton, Canada.