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Clinical Psychology at the Crossroads: An Introduction to the Special Issue on Nonlinear Dynamical Systems

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Abstract: *This introduction to a special issue of Nonlinear Dynamics, Psychology and Life Sciences discusses the contributing articles within the issue from a variety of perspectives. This analysis examines each article's contribution to understanding the self, and to exploring the application of innovative nonlinear methods to clinical questions. Moving beyond the special issue, the analysis examines the role of nonlinear science in clinical psychology from the perspective of Aristotle's four types of cause: material, efficient, formal and teleological. It is suggested that nonlinear science is particularly well-suited to empirical science aimed at understanding formal (i.e., systemic), and teleological (dynamical) causes. The strength of nonlinear dynamical systems methods in addressing formal and teleological cause could help bridge the gaps in understanding clinical phenomena using the medical model, which focuses primarily on material and efficient causes. Finally, a list of the top ten nonlinear dynamical systems concepts is presented with the goal of direct applications that may be useful for clinicians.*

Key Words*:* clinical psychology, psychotherapy, personality, self, causality

INTRODUCTION

From a great variety of perspectives, one may see Clinical Psychology as a cross-roads discipline. We endeavor to bridge the understanding of body and mind. We debate the art and science of our clinical decisions and strategies, as we struggle to find a training model that can satisfy these dual competencies (Norcross, Sayette, & Pomerantz, 2018; Sayette, Norcross, & Dimoff, 2011). We practice at a sort of cross-roads between modern material medicine and the ancient healing arts, as we struggle to define ourselves in modern terms without foreclosing to materialist myopathy. Despite our firm foundation and ongoing identification as scientist-practitioners of various stripes, the nature of the phenomena we investigate and "treat" push us to the edges of scientific discovery itself. The articles within this special issue can be viewed from a variety of perspectives, for example: How do we understand "the self?" Within this broad

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question, Cutler and Neufeld (2019) ask: How does neurological EEG patterning relate to disruption and dysregulation in the dynamics of self-hood? Cerezo, Pons-Salvador, and Trenado (2019) ask: How does the self emerge and become structured within our initial interactive dynamics with a primary caregiver? Halfon et al. (2019) ask: How does developmental psychopathology emerge, and become self-correcting through developmental play? Pincus, Cadsky, Berardi, Asuncion, and Wann (2019) ask: How is the shape of the self related to functioning? Scholler et al. (2019) ask: And can we model the self mathematically in such a way as to understand the mechanics of psychotherapy process? With questions such as these, it is no wonder that our science exists at a cross-roads, and why nonlinear dynamical systems theory represents such a useful potential bridge for discovery.

The science-practice gap is perhaps most visible than in the field of psychotherapy. Since Eysenck's (1952) forceful challenge of the efficacy of psychotherapy, the newly developed "scientist-practitioner" model of Clinical Psychology has responded with perhaps the most rigorous scientific testing of any approach to intervention that has been seen in the history of healthcare (Wampold & Imel, 2015). All these years later, the efficacy of psychotherapy is settled science (Wampold & Imel, 2015). Ironically, however, the field has made very little progress in understanding the process of psychotherapy, the causes of psychopathology, or the complex biopsychosocial etiological processes underlying psychological resilience and psychopathology. As such, mental health, one of the most costly and ubiquitous problems in world health, lacks a clear, unified, scientifically grounded model of etiology, assessment or diagnosis. Furthermore, psychotherapy, one of the best validated and safest interventions in all of health care, suffers from a lack of unified, scientifically grounded theory of psychological change.

Without a comprehensive theoretical grounding that is capable of understanding multiply determined, complex biopsychosocial cause, the field remains incapable of such basic functions as: idiographic assessment that accounts for complex etiology, explaining outcomes based on structural assessment, developing more effective, efficient and targeted therapeutic techniques, and providing a common framework for training clinicians in useful research practices and integrative interventions. Similarly, the lack of general theory in psychopathology or resilience leads to never-ending debates among proponents of various etiological and psychotherapeutic "micro-theories," battling one another for "The Truth" across the biological, psychological and social factorial spectra (Wampold & Imel, 2015).

Over the past decade, there has been an emerging movement of clinical scientists who suspect that the major barrier to understanding psychopathology and psychotherapeutic treatments lies not in our phenomena or in our training, but rather in the underlying theory and methods of traditional, linear research. The "medical model," is after all at best a model, and more accurately a socio-politically motivated metaphor (Elkins, 2009; Wampold & Imel, 2015). If clinical psychology as a discipline seeks respectability and resources within the modern

medical contexts, then it makes sense to adopt the metaphor of "disease" via external pathogen, and to consider interventions to be able to target and eradicate the pathogens in some simple and proportional manner. Indeed, science guided by reductionism and linear research design has proved to be pretty well-suited to the simple question of psychotherapy efficacy – "yes" psychotherapy works. However, after decades of stagnation, the medical model appears very poorly suited to understanding complex etiology, psychotherapy process, or how the two may be reconciled (Pincus, 2009, 2015, 2016).

The field of clinical psychology generally will acknowledge that psychopathological and psychotherapeutic processes are inherently multivariate, complex, and dynamical. Therefore, it is straightforward to suggest that in order to better understand and enhance the processes that underlie psychological health and healing, perhaps the field may benefit from models and methods capable of capturing such processes as they actually unfold in time. This special issue is aimed at gathering together some of the latest developments in this work, and includes broad sample of topics applying nonlinear dynamical systems to understanding brain-behavior dynamics, developmental processes, structural assessment, psychotherapy process, and psychological resilience. The papers herein are also diverse in their methods, populations, topics and models. They range from infants to adults. They focus on physiological measures, self-report and behavioral observations. They involve simulations, empirical data analysis, reviews of key topics, and some practical applications. Some more specific topics include: (a) network flexibility models of psychopathology; (b) emergence, phase transition, differential equation, and synergetic models of psychotherapeutic process; (c) the use of state-space grids to understand microsocial dynamics in development; and (d) the putative connections between complexity in EEG signals and psychopathology. Tying these articles together is an appreciation for the flexibility within models and methods from nonlinear dynamical systems theory, and a common movement away from the unnecessary statistical constraints of the general linear model and from the linear reductionism underlying the medical model.

REDUCTIONISM, THE MEDICAL MODEL, AND FOUR TYPES OF CAUSE

From a broader vantage point, clinical psychology may be seen to lie at the cross-roads of science and pseudo-science, with the struggle to remain firmly in the realm of science leading to some distortion of our basic understanding of cause itself. Clinical Psychology occupies the territory formerly held by spiritual and shamanistic traditions. The field held on tightly to its academic and scientific grounding, resisting societal needs and free market pressures to shift more toward a practice model until the mid-1940s in the United States, when the needs of the World War II veterans and a growing middle class became too great to ignore (Farreras, Routh, & Cautin, 2016). In 1949, the Boulder Model was developed, representing a conservative shift toward clinical practice, with training defined by the "scientist-practitioner" model, emphasizing the clinician as independent

scientists, with each role informing the other. This shift into practice is like yesterday in comparison to the emergence of modern medicine in the 16th century renaissance; this relatively brand new profession has been under constant pressure from within and without from inception to the present day. The pressure comes primarily from the role of science within the training model. From the discipline within, the "Practitioner Scholar" or "Vail" model was developed as an alternative training model in 1973, allowing for clinical psychologists with less academic rigor and scientific training to be included within the field (Norcross, Ellis, & Sayette, 2010). Then, around 2008, the most scientifically rigorous model yet, the "Clinical Scientist" model was developed, as a counter-reaction to the perceived weakening of the scientific standards of the growing numbers of practitioner scholars within the field (Baker, McFall, & Shoham, 2008).

From outside the discipline, a confusing web of overlapping mental health disciplines has emerged. Psychiatry lies at one end of the scientific spectrum, as a medical discipline steeped in linear interventionist training and primarily serving the role of prescribing medications for "mental illnesses." Additional professions licensed to assess mental health and provide interventions include: nurses, social workers, a variety of counselors, and marriage and family therapists. Each of these professions has a unique history and relationship with scientifically informed practice, none of whom place as strong a value on science as do clinical psychologists. Beyond the professions, lie the non-professional industries, which include various forms of unregulated "life coaches" and similar secular titles, along with the modern market-situated iterations of ancient spiritually-guided practitioners: the fortune tellers, tarot card readers and energy healers of various stripes. Far from the economic fringe, these hold-outs from scientific concerns are by most accounts booming industries, surpassing the growth of licensed psychotherapists in both demand and in financial earnings over the past 30 years (Miller & Hubble, 2017).

Ambitious as it may sound, the theoretical constructs, models, and methods from nonlinear dynamical systems may be particularly helpful in reconciling some of the apparent challenges to a scientific approach to mental health knowledge creation and clinical practice. Rather than toggling back and forth between training models with greater and lesser rigor, using interventionist, reductionist, and linear thinking as the benchmarks of such rigor, perhaps clinical psychology can better secure its professional niche by embracing a rigorous scientific perspective that allows for disproportional (nonlinear), change over time (dynamical) through complex and over-determined sets of causal factors (systems)? Indeed, such a perspective is not at all new. It has existed for thousands of years, within the formation of western scientific traditions. One need only let go of the pressures surrounding the field, from the linear reductionism of psychiatry, from the radical constructivist leanings in some parts of the master's level therapist professions, and from the non-professional and spiritualistic appeals of the coaches and the energy hucksters.

Once these distractions are set aside, one can examine the capricious nature with which the medical model unnecessarily oversimplifies the concept of

"cause" itself. Lying within the foundational scientific philosophy of Aristotle one may find, perhaps, a rationale for the broader perspective on cause afforded by the nonlinear dynamical systems perspective. A broader perspective that may allow clinical psychology to maintain its emphasis on scientific principles while keeping pace with the complex nature of the phenomena we study, and also the needs of practitioners as they work within the complex flows of human experience.

Specifically, Aristotle proposed four overlapping types of cause that underlie natural phenomena: material cause, efficient cause, formal cause and teleological cause (Bodnar, 2018). Roughly speaking "material cause" refers to the substrate upon which something is built, and can be seen to overlap with the biological-reductionist approach to science in clinical psychology, often considered colloquially to be the "hard science" approach, focused on underlying neurological processes, genetics, hormones, immunology, the microbiome in the gut and so on. Cutler and Neufeld (2019) are a good example of clinical research grounded in a balanced approach to material cause in their review of EEG dynamics and mental health. Importantly, they examine material processes (EEG) without oversimplifying, embracing the potential role of form (i.e., entropy) and change over time.

"Efficient cause" refers to something external to the material substance of the agent that is caused, which serves as a proximal trigger for some effect. One may see here an approach to science that adopts a disease model, defining symptoms for which one may then search for efficient cause, or the driving force behind the behavioral movement within American psychology beginning in the 1920's, which focused on conditioned stimuli acting from the environment upon relatively passive organisms. Within this special issue, a balanced approach to efficient cause may be found in Cerezo et al.'s (2019) examination of the timing of maternal responses to infants in relation to their emergent attachment styles. Again, this research endeavor does not oversimplify in its view of efficient cause, but instead accounts for sensitive periods in formal development of the infant.

Moving in the direction of more complex and dynamical cause, "formal cause" refers to the broader configuration of a material substrate. Like two houses, each made from brick, but having very different architectures, two individuals may have similar genetic and biological constitutions, and yet emerge over time with very different personality and resiliency profiles (e.g., multi-finality). Although it is complementary with material cause, formal cause may be seen to support the scientific investigation of system dynamics, perhaps most clearly the various approaches to modeling self-organization and structural resilience in clinical psychology (Pincus & Metten, 2010). Finally, teleological cause is concerned with the function, purpose or final state of a causal process. Along with efficient cause, one can see that this perspective on cause takes into account trajectories, or dynamics, as well as the importance of timing itself on the outcomes of efficient causes. Timing matters.

Each of the articles in this special issue may be seen as a clear example of the desire to more fully understand formal cause, within the context of

teleological cause, specifically the role of dynamical structure in psychopathology and resilience. For example, Pincus et al. (2019) examine the relationship between the complexity of personality organization and psychosocial resilience, Halfon et al. (2019) examine the structural dynamics underlying healthy change processes in child play therapy, and Scholler et al. (2019) examine a formal mathematical model of personality dynamics within the context and in adult psychotherapy.

One may recognize that material and efficient cause map more closely with what may appear stereotypically and superficially to be more "scientific": the search for underlying, simple biologically based mechanisms for mental illness or psychological resilience. By contrast, a focus on formal and teleological cause may not fit the common stereotype, and thus may be undervalued within the context of cultural and economic pressures on the field of clinical psychology. Meanwhile, scientific exploration of the organization and temporal evolution of psychopathological and resiliency processes are clearly necessary to understanding clinical phenomena. Rather than foreclosing on artificial and inaccurate distinctions among these four overlapping facets of cause, the field of clinical psychology will benefit from a full embrace of each, as well as the flexibility to shift from among each of these potentially useful perspectives. One may consider this strategy in exploring the contributions to this special issue.

PRACTICE MAKES PERFECT
TOP 10 NONLINEAR DYNAMICAL SYSTEMS CONCEPTS FOR PRACTITIONERS

When Freud emphasized the role of the unconscious, clinicians were empowered to wonder about and attempt to gain access to information outside of everyday awareness. When empirically-grounded trait-based approaches to assessment became well-developed, clinicians could use those traits toward a greater understanding of individual dispositions, abilities, and influences on psychopathology and resilience. When empathy emerged as a core feature of psychotherapy, necessary for the therapeutic alliance and positive client development, clinicians were better able to attend to the process of empathy and to use this process to help the people they serve. Common among these research endeavors is the fact that, beyond the more demanding process of empirical study, simply naming a clinical construct can facilitate some usefulness in clinical psychology. The nature of psychopathology and psychotherapy is so multi-dimensional, it can be easy to overlook potentially important facets of assessment and intervention simply because they have not been sufficiently named.

Within this spirit, it is proposed here that there are a large number of nonlinear dynamical systems concepts that may already be helpful in clinical practice, even as the field awaits the potentially long process of empirical study that will further clarify their details. As such, please consider this top ten list with a grain of critical thinking and more than a hint of open-mindedness. The spirit is well-intentioned, to begin bridging the gap for clinicians on the front line of care as quickly as possible with some of the perspectives that logically follow from a nonlinear dynamical systems vantage-point.

10: Entropy is Information

With the discovery of self-organizing processes (e.g., Prigogine & Stengers, 1984), Shannon's (1948) original notions about information and entropy were reconsidered (Guastello, 2015). Rather than information reducing uncertainty, uncertainty or entropy was considered to *be* information. This foundational principle of modern information theory can be helpful within the process of psychotherapy in a variety of ways. For example, most good clinicians and clinical trainers will recognize the paradox of expertise in psychotherapy process. It is common for supervisors to guide their trainees to 'leave their training at the doorway of the consultation room, and instead, work to cultivate a naïve stance regarding their clients' particular phenomenological experiences. Similarly, and unlike most medical consultations, it is more frequently the goal of psychotherapeutic inquiry to arrive at a state where the client says "I don't know?" rather than to ask closed-ended questions that would inform some decision tree about this or that medical intervention. Furthermore, when the client arrives at an "I don't know" response to a query about some aspect of his or her experience, the clinician should be energized and optimistic, rather than confused or frustrated.

The naïve stance of the clinician and arrival at the boundaries of client awareness each allow for the potential to cultivate novel information, bringing entropy to bear on a relatively closed experiential system. If one assumes that part of the formal and teleological cause processes that bring the client in to treatment relate to stuckness or stagnation, it then makes perfect sense that entropy in the form of novel information may be helpful in and of itself. More broadly, the most general process of psychotherapy may be expanded through an appreciation for information as entropy, as one is enabled to more boldly interrupt client discourses that are overly repetitive, and to seek out novel sources of information: "Yes, we've already been over this material; but what I'm really wondering is…?" Such an understanding of information entropy helps to inform most clinical understanding of empathic process, where one is on a continuous search for novel information just beyond a client's current bounds of experiential awareness. Empathy becomes a process in which one may directly search for key information that may transform the overly stuck or reactive aspects of a client's experience, such as the processes underlying cognitive restructuring (Ellis, 1979), the various approaches to behavior analysis (Baldwin & Baldwin, 2000) or the practice of correcting emotion with emotion (Greenberg, 2016).

9: Uncertainty

While the concept of uncertainty overlaps with information entropy, it is valuable enough in its own right to warrant individual focus. Besides a search for uncertainty to provide novel information, uncertainty is also a universal existential concept that underlies anxiety and the breadth of experience of being a human (May, 1977, 2009). Uncertainty can be understood as something to be both accepted, and also minimized within psychotherapy. For example, the uncertainty of value judgements, about the self, others or life itself will often need to be

navigated in psychotherapy. Inasmuch as the uncertainty around life value and meaning can be accepted, clients may be able to select life goals with clearer and more certain outcomes and to ground their more existential decisions in freely chosen values (e.g., courage, strength, generosity and self-respect) rather than relying on uncertain outcomes (Hayes, Strosahl, & Wilson, 1999).

Rather than relying on notions of uncertainty from existential philosophy, nonlinear dynamical systems provides some theoretical and empirical grounding for the ubiquity of uncertainty in human affairs. Not only do we live in a complex world as the cliché suggests, we are built from complexity. In particular, we evolve through shifts, often abrupt, in our underlying dynamics. In this sense, human beings are non-stationary creatures, particularly in our psychological and social domains which are of focus in assessment and psychotherapy. If we accept this relatively straightforward assertion, it only makes sense that psychological resilience often involves the need to let go of unrealistic goals for stability in one or more life domain, and instead to choose our identities across those frameworks, by focusing on the abstract value-principles that may ground our decisions no matter how turbulent things should ever become.

8: State Space and Topology

Clinicians, both in assessment and in psychotherapy roles, can benefit from topological thinking or imagining state space when conceptualizing clients' situations. Interpersonally, conflict may fruitfully be seen as a fixed point or limit cycle dynamic over time, as can enmeshment or power-dynamics. Each involves topological constraint, and improvement may be considered in terms of increasing space of free movement in the space of interpersonal parameters. Efficiently, the same modeling mindset may be useful in understanding the problem-space of a client struggling with problem solving, with effective intervention serving to expand the solution sets of particular clients. Similarly, avoidance processes underlying depression and anxiety and the great variety of defense mechanisms may be understood in terms of topological rigidity, with areas of client consciousness acting as repellors. Finally, mindfulness processes and practices may be considered to be counters to such topological processes of constraint, as one cultivates openness to bypass such topological rigidity, and experiential acceptance to decrease the need for repellor processes to maintain coherence within the sense of self.

7: Embodiment

From Gibson's (1977) perspective on ecological cognition to the latest attempts to measure embodiment as a synergetic system (Anderson, Richardson, & Chemero, 2012), the nonlinear dynamical systems perspective allows clinicians and researchers alike to easily allow for the body, the mind, and interpersonal processes to be seamlessly woven together in our understanding of perception, self, and relations with others (Tschacher & Bergomi, 2011). On a practical level,

synchronization in movement and bodily states can be processes that clinicians track over time in attending to the therapeutic alliance and empathy (Ramsayer & Tschacher, 2011), and the perspective of a client from within a body can be relevant for understanding the phenomenology of psychopathology ranging from psychosis to depression (Doerr-Zegers, Irarrazaval, Mundt, & Palette, 2017; Tschacher, Giersch, & Friston, 2017). Even the ubiquitous first stage of psychotherapy, remoralization, can be reconceptualized to be a process of lifting a client's sense of self to a higher level of perspective, beyond the limitations of one's immediate and often demoralizing sensory experiences (Frank & Frank, 1991; Orlinsky, 2009).

6: Boundaries

Boundaries are one of the most ubiquitous constructs in psychotherapy and psychotherapy training. The term is applied to the practice of ethics (e.g., boundaries around the therapist-patient relationship), to assertiveness and interpersonal approaches to individual therapy, and are key constructs in couples and family therapy as well. Yet all too frequently, it remains left unasked: "boundaries around what?" What exactly are boundaries, and what exactly are they holding in (or out) and why? Adopting a nonlinear dynamical systems framework, these basic questions are more easily addressed.

Most simply, boundaries are for holding information, and serve a functional purpose in holding together self-organizing systems (Pincus, 2009). Indeed, chaotic basins, self-organizing dynamics, and networks all have boundaries (often fractal boundaries). These boundaries constrain the flow of information within these systems and between these systems and their larger nesting contexts. In this way, the boundaries hold the system together, they are a key observable organizing facet within the process of self-organization. At the same time, the relative constraint of a boundary will serve a function in regulating the coherence of a system, more constraint equals more coherence.

But this is only a generalization. One may form a distinction between internal and external boundaries in a self-organizing system. In psychotherapy, for example, the rigid *external* boundaries around the therapeutic relationship (e.g., confidentiality, role boundaries and relative anonymity of the clinician) may serve to paradoxically make it safe to open up the space within the relationship to broader aspects of a clients' experiential information. In other words, strong external boundaries may allow for a therapeutic softening of internal boundaries. Similar dynamics may be useful in understanding the various ways in which increasing the clarity and coherence of clients' sense of self and identity may paradoxically allow them to open up to broader flows of experiential information (Pincus, 2009).

5: Networks

Thinking in terms of causal networks can be of major assistance in diagnostics, assessment, and in treatment planning. For example, with an ear for

network dynamics, one may inquire about symptoms in a manner that moves well beyond the symptom counting strategies of the medical model. Instead, one may listen more to the story of symptoms that clients tend to want to tell, how different symptoms effect one another over time. This approach to studying symptoms as networks, rather than as outcomes of some specific psychological syndrome (e.g., depression or anxiety) is already making good headway in the empirical literature (Fried et al., 2017). Yet, most clinicians who use some form of collaborative case formulation with their clients will easily recognize this empirical approach as something that has been embraced in good practice for some time.

For example, one is already using a network approach in a situation wherein a client describes a depressive process in which a sad mood leads to withdrawal, which leads to worry and rumination, which leads to insomnia, which leads to more worry and then to more withdrawal and sadness. The network aspects are especially salient for the clinician who attempts to identify and address the "hub" symptom first and foremost, which symptom impacts the most other symptoms over time (in this scenario most likely "worry"). The network approach is also helpful in understanding reactivity (i.e., density of network ties) and broader aspects of self-regulation (e.g., adding nodes of information, such as key coping behaviors) or working to decrease reactivity in key network ties or across the entire network through specific and targeted interventions. This network perspective can open one's eyes not only to the usefulness of framing targeted interventions, but also to the potential for unique network configurations across a variety of clients that ostensibly have the same "diagnosis." Such thinking leads the way to idiographic assessment, case conceptualization and treatment planning that is grounded in firm scientific modeling principles (Schiepek, Eckert, Aas, Wallot, & Wallot, 2015).

4: Timing

Any well-trained clinician understands the importance of timing. It is entirely ubiquitous to all aspects of psychotherapy. Timing frames the individual session, with checking in and assessment beginning most sessions, active intervention and deep exploration slowing down around the mid-hour, and consolidation and forward thinking at the end. Across session, timing is key as well, mirroring the within session processes and ideally serving as a continual flowing experience despite the breaks between office visits (Yalom, 2003).

Despite this central role of timing, the linear-interventionist perspective and medical model are hard pressed to account for even this rudimentary role of timing in psychotherapeutic "treatment." For example, if interventions work through efficient cause, and are generally linear and proportional in their effects, then why not see a patient for 20 hours in a single week and then be done with therapy, rather than stretching the process over 20 weeks or more? Furthermore, *timing* of any intervention, even an intervention as simple as "how do you feel?" will have a far different impact depending upon when it is asked, and where it is asked in relation to a client's experiential state space (Bornas, Noguera, Pincus, & Buela-Casal, 2014). If the timing is such that a client is relatively open to

answering a feeling question, some novel information will likely result that can be particularly healing. If the timing is off in relation to such experiential leverage and momentum dynamics, then the intervention will likely go nowhere. Holding the concept of nonlinear dynamics in mind during the therapy process, then, can be quite helpful in assisting both clients and therapists in understanding the importance of time and timing in psychotherapy.

3: Structure Matters

When considered from the perspective of self-organizing systems, a key clinical question emerges with any case: *From where does this client obtain structure?* In treatment contexts, this attention to the functional role of structure in one's life is another of the useful, yet not fully understood, clinical constructs for understanding pathology, resilience and healing. Common examples in which a pathological process becomes quasi-adaptive for people can be found in compulsive-addictive processes (Pincus et al., 2014), in the cyclical and ambivalent processes of negative self-relations and negative emotions (Greenberg, 2016), within interpersonal conflicts (Pincus, 2014), and when illness takes over one's identity (Pincus & Sheikh, 2009). Trying to "remove" symptoms without first considering the ways in which they may be bringing structure to a client's life or sense of self are only likely to bring about strong resistance. Such resistance makes perfect sense, and thus can be more easily navigated, when considered from the perspective of self-organization and the general need for structure to continue to exist.

Within the assessment role, structure matters as well. For example, when looking at an assessment profile, most experienced assessors understand that it is just as important to consider the configuration of traits or abilities as it is to consider the score on each individual aspect. For example, Piaget recognized the importance of "decalage," or the relative developmental variance among skills that emerges within a stage of development. For example, if an adolescent reaches formal operational thinking (e.g., abstract reasoning) prior to the development of commensurate emotion regulation abilities, the parents may be in for some intense arguments for the next few years until the emotional development is able to catch up to the cognitive. Similarly, variance among abilities in learning disability diagnoses will best inform interventions, rather than simply examining for relative strengths and weaknesses compared with same-age norms. As is a theme, a nonlinear dynamical systems perspective is very helpful in tailoring clinical information to a particular client's situation, without losing one's value for scientific or empirical explanations.

2: Rigidity and Flexibility

One of the most useful and fundamental attributes of a complex self-organizing system is its ability to tune its own parameters in response to perturbations. More simply, such systems can shift from rigidity to flexibility depending on particular demands. Relatively closed, tight and coherent states are

robust to shocks from without or within. Such states are robust. Relatively open, loose and flexible states are better able to explore and grow. Within the context of a fractal, or other complex organization, such flexibility may provide resilience. Indeed, such fractal or quasi-fractal self-organizing dynamics may even allow for anti-fragility, where complex systems grow and adapt in response to challenge (Teleb, 2010), for example in cases involving post-traumatic growth (Jayawickreme & Blackie, 2014).

As clinical scientists work out the details on when and how such anti-fragile mechanisms work, and how particular psychological systems move from flexible to rigid and back, clinicians can be mindful of such dynamics, and the adaptive roles that they play. For example, clinicians can track and engage clients in tracking the relative openness and closed-ness of patients week after week and within particular sessions. Clinicians can similarly track the movement between these states, the meta-flexibility (i.e., the flexibility in moving from rigid to flexible and back, Pincus & Metten, 2010) of client's emotions, habits, beliefs, and interpersonal processes. One may even make note of hysteresis, and other threshold effects, which may signal key areas of developmental disintegration that can be addressed and resolved within psychotherapy. As with the prior eight concepts, if one can't name and study them, they are unlikely to be noticed within the process of assessment and treatment. Yet, once named, they may be useful even prior to detailed empirical explanation.

1: Aristotle's Four Types of Cause

For the number one nonlinear dynamical systems construct that is already useful in clinical psychology, we come full circle back to formal and teleological cause in addition to material and efficient cause. In assessment and intervention, effective communication in feedback with clients is critical. One area of difficulty, is in helping clients to understand our role, as well as the role of psychological assessment and intervention. As part of medicine, and within a western socio-cultural context, clients will understandably expect clinical psychologists to behave like physicians: namely to tell them what is wrong and to provide some sort of relief. Beyond the limitations of the medical model, these expectations can be understood to be framed through the limitations of thinking in terms of material (e.g., neurochemical imbalance) or efficient (e.g., things make me too angry) cause. As such, they desire an understanding of what is wrong with them physically, and what can be removed, even if this perspective is likely to make things worse rather than better.

Without waxing too deep or philosophical, it does not take too much mind-opening for clients to see that clinical psychology holds a broader lens on cause itself than does the stereotype of the medical model, a view of cause that goes back to the Aristotelian fundamentals of scientific thinking. Namely, we also consider formal cause, how things connect with one another in ways that are often quite unique for each individual. As a result, we need to do a thorough assessment of a range of factors, and work with each client in collaboration to identify the most important areas to target our interventions – be they behavioral, cognitive,

emotional or relational in nature. At the same time, we need to understand each client's life in a developmental context, where has life been headed at different points in time: teleological cause. Most clients are welcoming of a process of assessment that explicitly takes into account where the twists and turns of life, efficient cause factors that knocked things off of its optimal path, and the development of effective strategies to return one's life trajectory toward a better future.

CONCLUDING REMARKS

This special issue is a single step in a growing path of a winding road. Progress will continue in these four broad methodological areas represented herein: (a) symptom network models of diagnosis and response to treatment; (b) phase transitions, Markov transitions, differential equations, and synergetic models of psychotherapeutic process; (c) synchronization and other emergent processes within the therapeutic relationship; and (d) integration of various approaches to psychotherapy using nonlinear dynamical systems concepts. New paths forward will emerge. As they do, it will be important to keep an eye on the value of integration: science-practice, part-whole relations, aspects of cause, and integration of self and experience within the people we aim to serve.

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