**Complexity Science: A Framework for Psychotherapy Integration**

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**Abstract**

The complexity science paradigm provides a new way to address the problem of psychotherapy integration and allows to bypass the various shortcomings of the linear-interventionist perspective. Nine criteria are outlined which should be satisfied by any integrative theory of psychotherapy: (1) The use of complexity science to provide a meta-theoretical and generic understanding of change processes (from neuronal to the social-system levels); (2) a comprehensive and formalized modeling of change processes and personality development; (3) an integrative method of case formulation; (4) the ability to understand a variety of techniques in terms of basic change principles; (5) criteria to guide micro-decisions; (6) the application of data-driven feedback and real-time monitoring of change dynamics; (7) standardized assessment of outcomes in naturalistic settings; (8) guidelines for training; and (9) strategies that are well-suited to science-practice integration. Using these criteria as a framework for evaluation, one may better grasp the potential of complexity science to drive innovation in the pursuit of psychotherapy integration.

**Key words:** psychotherapy integration, complexity science, psychotherapy feedback, case formulation, personalized psychotherapy

**Public Significance Statement**

This article proposes nine criteria for psychotherapy integration based on the paradigm of complexity science. In addition to presenting a general framework for psychotherapy integration, this article proposes some concrete implications for clinical practice, including methods for personalized and feedback-driven psychotherapy, case-formulation, and practice-driven research strategies. Specifically, an internet- and app-based tool designed for collecting and analyzing time series data over the course of treatment is introduced.

**Introduction**

The aim of this article is to delineate a new approach to psychotherapy integration. It is based on complexity science, which is an umbrella term for different theories and methods to understand complex systems, e.g. chaos theory, Synergetics, and nonlinear dynamics. Because of the formal structure and mathematical kernels of these theories, complexity science can be broadly applied and is transdisciplinary. Due to its abstract nature it may be sufficiently different from specific concepts within psychotherapeutic schools. However, it may be specified and concretized to be useful in psychotherapy practice (e.g., guiding practice, evaluation, training, and research).

The development of integrative frameworks has been a longstanding challenge. Just a few of the major milestones would include the idea that common factors underlie the various approaches or schools (Rosenzweig, 1936), the generic model of psychotherapy (Orlinsky et al., 2004), and Grawe’s concept of general psychotherapy (Grawe, 2004). More contemporary formulations of common factors research led to the contextual model of psychotherapy (Wampold & Imel, 2015), and to other transtheoretic and transdiagnostic concepts (e.g., Epstein & Epstein, 2016; Goldfried, 2010; Wachtel et al., 2005), also including neurobiological reasoning (Kinley & Reyno, 2016). Norcross and Goldfried (2005) recognized four general routes to integration: common factors, technical eclecticism, theoretical integration, and assimilative integration. In the Discussion section of this article we will compare our approach to each of these.

The motivations for the efforts toward psychotherapy integration are numerous. Of key concern is the large and growing number of distinct schools or approaches, which is too large at 500 or more (Prochaska & Norcross, 2013). This proliferation creates barriers to training, professional development, and scientific progress. With no “winner” from among the approaches expected (Wampold & Imel, 2015), integration is necessary to understand how psychotherapy actually works (Kazdin, 2009). Finally, integration is necessary to reach the goal of connecting psychological mechanisms of change to related neurobiological processes (e.g., Cozolino, 2015; Schiepek, 2011).

Even more profound scientific problems have emerged in the last few years, the first of which is research demonstrating the minor contribution of treatment techniques to outcomes (Wampold & Imel, 2015). A second problem is the growing doubt on the actual evidence for “evidence-based” therapies, particularly if one moves beyond *efficacy* (can the treatment work under controlled conditions) and into *effectiveness* (does the approach work in real-world conditions) (Shedler, 2018). Finally, psychotherapy should be the application of treatments carried out in “the correct way,” often taken to mean adherence to specific treatment manuals. Yet, adherence does not appear to bring about better outcomes (Webb et al., 2010; Wampold & Imel, 2015). Given this background, a variety of dynamic and nonlinear features of psychotherapeutic change are important for building a framework for psychotherapy integration.

**Criteria for the development of an integrative framework**

We propose the following nine criteria for the development of an empirically grounded integrative framework for understanding psychotherapy:

(1) *Genuine integration*: Integration should be based on a meta-theoretical perspective, which should ensure an advance beyond the eclectic mixing of approaches.

(2) *Comprehensive and process focused*: It should provide a theory of personality development and psychotherapeutic change.

(3) C*ase formulation*: Methods of case formulation should be able to combine multiple perspectives and hypotheses on the client’s problem(s).

(4) *Common strategies and eclectic techniques*: It should be able to use a multiplicity of treatment techniques from a diverse range of approaches.

(5) *Microsocial guidance*: Criteria for moment-to-moment therapeutic decisions should be provided.

(6) *Data-driven feedback*: Feedback from the ongoing process should support collaboration between therapist and client.

(7) *Standardized assessment of outcomes*: The same holds true for the assessment of treatment outcome in naturalistic settings.

(8) *Training*: For the training of therapists, a concept of skills and competencies should be consistent with the integrative theory.

(9) *Science-practice integration*: It should provide clear ideas on how to bridge the gap between practice and science.

**Complexity science as a paradigm for psychotherapy integration**

Complexity science is often used as an umbrella term for several other contemporary system theories, including Synergetics (the science of how complex systems self-organize), chaos theory, complex adaptive systems, or network science (Gelo & Salvatore, 2016; Haken & Schiepek, 2010; Pincus, 2009; Strunk & Schiepek, 2006). Each of these overlapping theories allows for the investigation of complex and potentially nonlinear causes that unfold over time, providing scientists and practitioners with a more appropriate set of assumptions from which to understand how psychotherapy actually works.

**Genuine Integration**

Importantly, complexity science is not linked to any specific therapy approach or to a specific psychological tradition (although there are similarities to the tradition of Gestalt psychology). Rather, the roots of complexity science can be found in physics (e.g., Haken, 2004; Haken & Schiepek, 2010; Strogatz, 2014). Early physical examples of spatio-temporal pattern formation in “far from equilibrium systems” were the highly ordered light emission of the LASER, fluid dynamics like convection rolls or cells, or chemical clocks and auto-waves. Other roots are in metereology which shares with psychology the complexity of the involved systems and the genuine unpredictability of the dynamics on the long run. In ecology nonlinear models and analysis tools of discontinuous transitions and their precursors have a long tradition (May, 1975; Scheffer et al., 2009; Sugihara et al., 2012).

In psychology, there are different applications of complexity science since some decades. Especially Synergetics was applied to phenomena like movement dynamics, perception (“pattern recognition is pattern formation”), memory, psychopathology (mental disorders as dynamic diseases), and social systems (Haken & Schiepek, 2010). From a structuralistic perspective on scientific theories (Stegmüller, 1973) Synergetics may be seen as a formal kernel with many successful applications in different disciplines. An important application is to one of the most complex systems we know – the human brain. For example, methods from Synergetics and neural plasticity are used to model dynamic synchronization patterns in the physiological and pathological functioning of neural systems (Deco et al., 2011; Friston, 2011). This transdisciplinary nature of complexity science is of particular importance for a theory of psychotherapy because neural, psychological and social mechanisms can be understood within a single, unifying scientific frame.

The most crucial criterion for complexity science may be its empirical evidence to understanding bio-psycho-social resilience and adaptive change (Pincus & Metten, 2010). In terms of interpersonal physiology, for example, nonlinear physiological linkage (the exchange of entropy in arousal patterns) occurs naturally during dyadic interactions and is moderated by empathy (Guastello et al., 2006; Kleinbub, 2017). Across the menopausal transition, nonlinear dynamics and coordination between stress and fatigue appear to undergo significant shifts that may serve as common systemic mechanisms for an array of symptoms (e.g., insomnia, anxiety, mood problems; Taylor-Swanson et al., 2017). Similar dynamics have been observed in behavioral flows, which appear to contain recurrence patterns that conform to self-similar branch-like structures known as *fractals*. The rigidity of these fractal structures is significantly correlated with self-injurious behavior (Pincus et al., 2014) and with resistance to behavioral interventions (Berardi et al., in press). General psychopathology is associated with rigidity among personality traits (Pincus et al., 2019). On the social scale, fractal recurrence structures have been found to shift toward rigidity in response to conflict (Pincus, 2014). In each case, similar scientific principles appear to apply to change at different levels of analysis.

This theoretical perspective has been supported by several studies of psychotherapy processes as well. For example, dynamical indicators of transitions have been observed in clients’ daily ratings of experience during psychotherapy, which include discontinuous transitions and critical instabilities that serve as precursors to these order transitions (Haken & Schiepek, 2010; Hayes et al., 2007; Olthof et al., 2019; Schiepek et al., 2016a,b), chaos (i.e., sensitive dependency of the dynamics on initial conditions, dynamic noise, and parameter values, which implies limited predictability; Schiepek et al., 2017) and shifting synchronization patterns among cognitive-emotional and neuronal activity (Schiepek et al., 2013). Similarly, studies have shown dynamic synchronization of the client-therapist interactions (Kleinbub, 2017; Kowalik et al., 1997; Ramseyer & Tschacher, 2008; Strunk & Schiepek, 2006), stability conditions as necessary conditions for change, and the appearance of order transitions before or independent of the timing of interventions (Heinzel et al., 2014). The complexity perspective’s embrace of complex cause, nonlinearity and momentum effects may help to explain the most challenging findings from psychotherapy research, e.g., small effect sizes of specific interventions and the “dodo bird” effect (Wampold & Imel, 2015), sudden gains or losses (Stiles et al., 2003), and the limited predictability of individual pathways to change.

**Comprehensive and process focused**

In addition to serving as a broad meta-theory, complexity science provides tools for building mathematically grounded models that include important psychological mechanisms of change and will be able to explain the known nonlinear features of therapeutic processes (Liebovitch et al., 2011; Rodgers, 2010). This modelling strategy was motivated by the fact that any knowledge on specific or common factors cannot explain dynamics without first connecting these factors within a model of change over time (de Felice et al., 2019).

Figure 1

By contrast, the theoretical model proposed by Schiepek et al. (2017) allows for nonlinear influences in common factors over time. It includes five state variables: (E) emotions, (P) problem intensity and symptom severity, (M) motivation for change, (I) insight and new perspectives, and (S) success, therapeutic progress, and confidence in a successful therapy course. These variables are interconnected by nonlinear functions, which are represented in mathematical terms constituting five coupled nonlinear equations (one for each variable). The control parameters of the model mediate the interactions of the variables and can be interpreted as competencies or dispositions. Depending on their values, the effect of one variable onto another is intensified or reduced. The control parameters are (*a*) working alliance and capability to enter a trustful cooperation with the therapist, (*c*) cognitive competencies, mentalization, and emotion regulation, (*r*) behavioral resources and skills, and (*m*) dispositional motivation to change, self-efficacy, and reward expectation (Figure 1).

Dispositions (traits) change at a slower time scale than states. Due to the effects that control parameters exert on the interaction of states, a continuous shift of one or more control parameters may have sustainable effects on the dynamic patterns of the system. In the sensitive range of the control parameters changing values produce discontinuous jumps in the dynamics (order transitions; Figure 2).

Figure 2

There is a circular causality from traits to states and from states to traits, from control parameters to order parameters, and from order parameters to control parameters (Schoeller et al., 2018). Four evolution equations describe the control parameter dynamics. Given this circular causality, even without any specific interventions, dynamic noise – unspecific events like daily hassles or happiness – can drive a positive trend of the parameters, which might be interpreted as personal growth or self-actualization. This could lead to spontaneous remission (order transition to healthy dynamics). In other realizations, and despite of multiple interventions, the circular coupling of traits and states remains under the threshold which could trigger an order transition.

Because of the nonlinearity of the functions, the system dynamics can realize deterministic chaos and sensitivity to specific interventions. At the edge of instability, small perturbations can shift the dynamic regime, and by specific inputs the activated dynamics can be switched on or off (e.g., from complex regularity to chaos and back to regular oscillations). Given specific parameter values, it seems possible to switch between different dynamic patterns, but only at appropriate moments. This corresponds to the “kairos” phenomenon of sensitive time slots for treatments. The switching effect is a proof of the bi- or multi-stability of the system which means that the system is able to create two or more dynamic patterns at the same parameter values.

The simulation results of the mathematical model illustrate the dependency of interventions on (a) timing and (b) duration of interventions, (c) the coupling strengths between order and control parameters, and (d) dynamic noise. The effects of interventions are sensitively dependent on these process-specific conditions (i.e., *self-organized thresholds* and *self-organized criticality*). A validation study revealed that feeding the model with data (initial conditions of the variables and the parameters, dynamics of the experienced working alliance, input onto the variables as perceived by the client) produces significant similarities to the simulated dynamics compared with the time series data of a real client (Schoeller et al., 2019). Mathematical modelling opens new ways of understanding the complexity of human change processes. One concrete application is the use of the model for training psychotherapists how to handle complex systems and to accept the limited manageability and predictability of nonlinear systems like humans. In the future, another application could be the use of the model as a data-driven artificial intelligence system for short-term predictions of critical events.

**Case formulation**

Individualized case formulation is necessary based on the limited specificity and flexibility of diagnostically driven treatment. One specific method of multi-perspective case formulation grounded in complexity theory is *idiographic system modeling* (Schiepek et al., 2015; Schiepek et al., 2016b) It is a co-creative process of the client and the therapist, producing a network model of the mental and social functioning of the client. Conceptual components of a system model should be ‘variables’ that can change over time and represent intra-individual or inter-personal components of a complex system (e.g., cognitions, emotions, motives, behavior).

The effects of the single components on each other are graphically depicted. Arrows show the inter-component effects, in the most straightforward cases qualified by a + or a –. + denotes a positive relation (e.g., ‘the more the client experiences lust for life, the higher the self-esteem’ or the other way round: ‘the less the client experiences lust for life, the lower the self-esteem’), – denotes a negative relation (Figure 3).

Figure 3

Idiographic models show direct interactions, loops between several components, or recursions of a variable to itself (autocatalytic effects). Increased crosslinking of the variables makes it possible to see connections that were previously unnoticed or were only considered as unilateral cause-to-effect-relations (“x is to blame for y”). After completion of the modeling, therapist and client make use of the questionnaire editor in the Synergetic Navigation System (an internet-based tool for process monitoring) and create an individualized process questionnaire. Using any electronic device for data entry (self-assessments) the therapeutic process can be monitored continuously and visualized as the client’s idiographic variables change over time. During the therapeutic process, therapist and client repeatedly refer to the model and to the time series of the change dynamics.

**Common strategies and eclectic techniques**

When the strategic focus is aimed at flexibility and connection, basic measurable features within any complex system, any number of interventions or techniques may be usefully integrated. For example, one may use insight-oriented techniques to increase connections and flexible relations among ego states on different time scales, while simultaneously focusing on a variety of here and now processes (e.g., experiential-acceptance). Exposure-based techniques can be re-conceptualized as aiming to increase one’s flexibility, as they bring greater awareness of the variety of emotions, bodily sensations, or images that enter awareness in response to some conditioned trigger (Hayes et al., 1999). Similarly, skills-oriented training and role-play can be re-conceptualized to be about engaging more flexibility of one’s responses to a stressor, rather than simply plugging a skill into a deficit. Furthermore, if the lack of skilled response is at all related to some negative developmental experience, then the skills-based procedure becomes entirely compatible with psychodynamic perspectives. Connection to the past ego state(s) and increasing flexibility in emotional awareness and coping are clearly compatible without the constraints imposed by individual schools of technique. The complexity science approach allows for a higher level of integration by focusing instead on the complementary processes of structure and flexibility, both of which are adaptive across the various aspects of experience (e.g., self, emotion, and habit).

**Microsocial guidance**

From the perspective of complexity science, psychotherapy provides the conditions for change via self-organization to occur (Gelo & Salvatore, 2016; Haken & Schiepek, 2010; Pincus, 2009, 2012; Schiepek et al., 2016a). Therapists are responsible for the client-centered and process-sensitive realization of these conditions, not so much for the application of standardized treatment protocols sorted by specific disorder. This distinction allows for a focus on the facilitative aspects of treatment, referred to as *generic principles* (Haken & Schiepek, 2010; Schiepek et al., 2015; Schiepek et al., 2019a). The following is a summary of these complexity-based generic principles:

1 Stable boundary conditions. Order transitions occur within stable boundary conditions. Supporting self-organized order transitions means to destabilize within the context of stability. Stabilization includes to create certainty about the structure (setting, transparency of the procedure), the quality of the therapeutic relationship, and activities that support the client’s internal growth (self-efficacy, sense of control and manageability, access to personal resources).

2 What is the system under consideration? It is necessary to determine to which system the intended processes of self-organization should relate. The structure of the system has to be modeled by methods of clinical case formulation which provide a frame of reference for the therapeutic process and for the decisions on therapeutic interventions.

3 Sense of significance. It is important that clients perceive their personal change as meaningful and in congruence with their own personal life goals. Especially in cases of crisis, when the personal sense of internal coherence are threatened it may even be more important that the therapeutic process – at least in the beginning – is compatible with the client’s schemata and basic beliefs. This corresponds to the dimension of “meaningfulness” in Antonovsky’s “sense of coherence” (Antonovsky, 1987). Only significant and meaningful projects warrant investment of resources and efforts.

4 Activation of control parameters and motivation for change. Change through self-organization requires, in the broadest sense, the energetic activation of a system. Specifically, order transitions require a certain activity level of relevant control parameters that drives the system from its equilibrium. Providing motivational conditions (e.g., approach goals; Grawe, 2004), activating resources (e.g. social support; Zuckerman, 2003), and intensifying emotional involvement of clients (Greenberg, 2002; Lane et al., 2015) may be the ‘energy’ required in psychological treatments.

5 Destabilization and amplification of fluctuations. Psychotherapy provides new opportunities for experiences. Consequently, existing cognitive, emotional, and behavioral patterns are destabilized during psychotherapy, which, in the beginning, can feel unsettling. The client experiences new and emotionally relevant states for an increasing length of time and in increasing magnitude (*deviation amplifying feedback*). Different techniques can be used to interrupt or to destabilize dysfunctional patterns. These techniques include exercises and role play, behavior experiments, exposure and cognitive restructuring, process interventions, corrective experiences, and many others.

6 Kairos, resonance, and synchronization. It is important that the applied therapeutic interventions match with a client’s current cognitive-emotional state because therapeutic efforts can only have an impact when the client is open to them and processes the input in a self-related way (Orlinsky et al., 2004). On shorter time scales, e.g., in direct conversations during therapy sessions, this matching pertains to aspects like synchronization or coupling of posture, rate and content of speech, pausing, and eye contact. Matching on this level is thought to be important because it creates the basis for mutual communication and influence (Kleinbub, 2017; Kowalik et al., 1997; Pikovski et al., 2001; Ramseyer & Tschacher, 2008). On longer time scales, matching contains aspects like the frequency of therapy sessions and ensuring that interventions are appropriate to a given state of the client. The term “kairos” denotes the timing of interventions as the key moments that offer greater impact (e.g., during critical instabilities, or using emotional momentum; Bornas et al., 2014).

7 Purposeful symmetry breaking. “Symmetry” means that in systems far from equilibrium and close to a transition threshold, two or more attractors (stable states) are equally likely to be realized. As it is small fluctuations that determine their realization, it is difficult to predict the system’s further development. However, there are situations in which certain patterns should be avoided and not left to chance (e.g., situations in which a client is at risk to commit suicide or at risk for relapse). Therefore, to steer symmetry breakings in a particular direction, certain assistance can be provided, e.g., some structural elements of a new order state can be realized for instance in role-play. Clients can be asked to imagine desired goal states or to anticipate certain desired behaviors to help them to steer symmetry breaking behaviors in a particular direction.

8 Stabilization of new patterns. Once positive patterns are established, they should be stabilized, automatized, and kept available. Here, techniques for stabilization and generalization of patterns play an important role, such as repetition, variation, or application in different situations and contexts.

Woven within the generic principles one may recognize the well-known process factors of psychotherapy, such as: informed consent, therapeutic boundaries, confidentiality, embracing uncertainty, cultivating curiosity and a humble stance, cultural humility, empathic process, congruence and self-awareness, and awareness of process (Pincus, 2015, 2016). One may also recognize that each of the generic principles can be understood structurally as facilitating both connection and flexibility within the therapeutic relationship and within the clients’ ongoing flow of experience.

**Data-driven feedback**

Despite the particular approach, contemporary psychotherapy is collaborative (Bohart & Tallman, 2010), client-centred (Pincus, 2012), and personalized (Fisher, 2015). As a result, clinicians work to pay attention to the client at a given point in time and to the actual state of the change process. The shape of the change trajectories may correspond to types of diagnoses or personality dispositions, and more than this, to a broader spectrum of attractor-to-attractor types which get visible by a sampling frequency of daily assessments. With the process as the reference for collaborative clinical decision-making, practitioners need good data on the ongoing process of change. There is increasing evidence that feedback is helpful in building on successes (de Jong et al., 2021; Kendrick et al., 2016; Lucock et al., 2015).

The Synergetic Navigation System (SNS, Schiepek et al., 2015; Schiepek et al., 2018) is a psychotherapy feedback platform that has been designed to provide feedback informed by complexity theory. By using this system, different process or outcome questionnaires are available and different sampling strategies (time-sampling or event-sampling) are possible. A specific feature of the system is a questionnaire editor which allows for the definition of individualized questionnaires, based on case formulations and other client-related information. Starting from idiographic system models, each variable of the model can be transformed into an item of a personalized questionnaire for measuring the dynamics of the respected variables. In general, outcome and process monitoring can be combined by using different questionnaires at different sampling rates. The SNS is designed to capture internet- or app-based ecological momentary assessments – reporting experiences of every-day life in close timely proximity to their actual occurrence, and data can be recorded through smartphones, tablets, or laptops.

The default option in clinical applications is the use of daily self-ratings with the Therapy Process Questionnaire (TPQ, Schiepek et al., 2019b) and to combine the quantitative assessment with electronic diaries. The TPQ asks for symptom and problem intensity, motivation for change, emotions, insight and creating new perspectives, self-esteem, self-efficacy and confidence in the process, mindfulness and body experience, and working alliance.

Besides outcome, therapy feedback should be sensitive to features of change processes like early rapid responses, sudden gains or losses (Lutz et al., 2013; Stiles et al., 2003), or rupture-repair sequences in the working alliance (Gumz et al., 2012; Stiles et al., 2014). Combining the common factors approach with therapy monitoring using the SNS results in a real-time assessment of common factor dynamics – which are nonlinear and chaotic (Schiepek et al., 2014; Schiepek et al., 2016a,b,c; Schiepek et al., 2017).

In addition, the SNS uses mathematical algorithms for tracking the nonlinear dynamics of change. Using this information, feedback on the relative stability over time is provided to both client and therapist. Therapists can utilize these markers within clients’ self-organizing processes and encourage clients to communicateand work through particular experiences that correspond to the ongoing feedback results. In this way, the SNS empowers the usual collaborative process within psychotherapy.

Figure 4

From the perspective of self-organization, one of the most important aims of therapy feedback is to get early warning signals on upcoming order transitions. In many cases critical instabilities can be identified before an order transition takes place; in other cases, a transient deterioration may be a precursor. Critical instabilities are represented by the measure of dynamic complexity, which combines the amplitude, the frequency, and the distribution of the values of a signal over the available range of a scale. The evolution of dynamic complexity can be presented as time series or as colored complexity resonance diagrams (Figure 4). In the resonance diagrams, vertical columns of increased complexity over many items indicate order transitions. Another common precursor of order transitions is increased synchronization among the emotions and cognitions of a client, as represented by the items of a process questionnaire.

Pattern transitions not only appear in changed mean levels of a time series, but also in their variability, rhythms, frequency distribution, complexity, or other dynamic features. The option of a superposition of time series in a diagram or the visualization of coloured raw data diagrams can show such synchronized or anti-synchronized rhythms in multiple time series.

Figure 5

Recurrence plots (Wallot et al., 2016; Webber & Zbilut, 1994) are another method that can be useful in identifying shifts in variables and network synchronization. Figure 5 illustrates the transition from one stable pattern to another (blue rectangles), with a short transient period in between (yellow to orange pixels). Recurrence Plots and Complexity Resonance Diagrams (CRDs) show complementary patterns: transient periods correspond to periods of critical instabilities, and increased dynamic complexity, whereas recurrent periods represent more relatively stable quasi-attractors.

Feedback methods, such as the SNS, are direct applications of the concept that any treatment “…only becomes *real* when it unfolds during the course of time,” and that “…all psychotherapies, even the most constrained and manualized treatments, unfold differently in each instance, due to characteristics of the therapist and the client” (Wampold et al., 2017, pp. 24).

**Standardized assessment of outcomes**

Up to now, the gold standard for treatment evaluation has been group comparison studies, especially Randomized Controlled Trials (RCTs), which necessarily tend to be carried out in settings that are far away from the usual settings of application. The ecological validity of RCT results is further limited by manualized and pre-defined treatment procedures that assume some degree of client homogeneity, by exclusion criteria that set out to make groups of clients more homogenous, and by the use of inherently invalid “placebo” metaphors (Wampold et al., 2016). In fact, the usefulness of any psychotherapeutic intervention may only truly be judged in a real-world situation – given a specific client, a specific therapist, a specific setting and the social context, and the actual dynamics of the process at a specific point in time.

Outcome monitoring should be applied in routine practice and can be seen as an important criterion of “good practice” (Lambert, 2010; Wampold, 2015). Internet-based monitoring tools as the SNS allow for this without additional burden on clients. Outcome questionnaires – from the perspective of the client or of important others – can be used at different time schedules, and first order (e.g., symptom reduction) and second order outcome criteria (e.g., quality of life, personality development) as well as first order (i.e., raw data) and second order analysis steps (i.e., complexity and synchronization measures) can be combined. Repeated measures especially during the after-care period will inform on the sustainability of the results.

Usually, treatment effects are considered as a change of the mean level of any criterion. From a complexity point of view it should be noted that psychotherapy effects also can emerge in pattern transitions with unchanged mean scores but changed dynamics. One obvious example is in the high volatility of emotions in a client with Borderline Personality Disorder, which may involve reducing the range or the degree of fluctuations (more emotional stability). By contrast, one may seek to increase the range of affective dynamics of a formerly emotionally frozen client (e.g., numbness or alexithymia). The rhythm of change (e.g., rapid cycles of a bipolar disorder) may be another important outcome, with desired shifts toward either increasing or decreasing chaos in emotional, behavioral, cognitive, or interpersonal dynamics (psychiatric disorders as “dynamic diseases”, Mackey & an der Heiden, 1982).

**Training**

From the point of view of complexity science, psychotherapy is defined as supporting self-organizing processes of client-related bio-psycho-social systems (Schiepek et al., 2015). This indicates that therapists should have competencies in understanding, modelling, analysing, and supporting complex systems (i.e., “system competency”). When one adopts this perspective, psychotherapy is not only applied psychology but applied transdisciplinarity. Knowledge on a diversity of human-related subsystems has to be integrated by the meta-theoretical framework of self-organization. In detail, systems competences include:

1 Social competence (contextualized and fitting language, sensitivity for the self-relatedness of the client, understanding the “culture” of the other, clarification of roles and expectancies, flexibility in self-presentation, team playing, respecting and reflecting rules, fitting the interactive patterns of others, skills in constructive and supporting feedback, supporting the self-esteem of others and of oneself, solving conflicts, competencies in transdisciplinarity, etc.)

2 Management of time (understanding and using the “eigendynamics” of systems, undergoing resonances and synchronizations, using the “kairos” of change dynamics, development of goals and new perspectives, working with prognoses and the limitations of prognoses, understanding nonlinearity, understanding cycles and phases of life without to belief too much in this, relaxed handling of irreversibility and unchangeable processes, accepting the limits of planning and technical interventions, changes from action and reflection, patience, slowness (“moving behind the client”), using time rituals, and so on.

3 Regulation of emotions and stress (focus on one’s own quality of life and health protection, using existing energies, empowerment, jiu-jitsu principle, activating of resources (one’s own and others’), concentration and focusing on important points, clarification of one’s own motivation, creating cultures, belongingness and “corporate identities” in social systems, activation of support systems and social networks, creating information links, coping with emotional strain (transparency, time pressure, conflicts, complexity stress, failures), tolerance of ambiguity and contradictions, etc.)

4 Creating conditions for successful self-organization. This point refers exactly to the “generic principles” which were detailed above. In addition, therapists need heuristic competencies for the enlargement of problem-solving spaces and for the development of new competences.

5 Knowledge (e.g., on the functioning of complex systems and nonlinear dynamics, informed practice relating to psychology, neuroscience, social and cultural science, psychotherapy research, psychiatry, philosophy, ethics, methodology).

6 Pattern recognition, assessment, analyzing and modelling complex systems (applying methods of assessment and measurement in psychology and psychophysiology, clinical case formulation, idiographic system modelling, methods of linear and nonlinear time series analysis, handling of feedback and monitoring tools like the SNS, therapeutic interviewing with reference to process data and analysis results).

**Science-practice integration**

A framework of psychotherapy integration should be able to offer some ideas on a conflict as old as psychotherapy itself, the well-known scientist-practice divide. Despite the long-term viability of the scientist-practitioner model, the problem continues.

Ideally, both the applied and scientific clinical work can be built upon a common process of internet-based data collection and data analysis tools such as the SNS. Using ecological assessment and feedback, therapists would produce rich data for research and be carrying out evidence-based practice simultaneously. The practical work of the clinician is based on the evidence of the actual state of the system under consideration. In a sense, the clinician and the scientist are one in the same.

This kind of digitalization allows for empirical research in practice; each therapeutic process becomes a single case study using a nested, multi-scale time series design that is perfectly suited to a great variety of modelling strategies. Beyond these single case time series designs, therapists contribute to *big data* sets – which will bring the field closer toward both personalized practice and clinical research that can leverage methods designed for big data (e.g., machine learning). Private practices and routine care institutions can be much better served by such an integrative science-practice system, with open-access allowing for the democratization of research projects. Any individual or clinic can develop and investigate their own questions about psychotherapy process, human change, and resilience. Ideally, this engenders an increase in professionalism and an empowerment of practitioners. Supervision and case conferences now contain a new level of data-driven quality, possibly also including clients in live sessions, and research gets access to big data from real-world settings. These are only some of the ways that a complexity science framework becomes a win-win situation for both – practice-based research and research-based practice.

**Conclusion**

In both practice and research of contexts, schools of psychotherapy or diagnosis-related treatment programs continue to be prevalent. Movement beyond these two limited frames of reference allows for new developments in the field of psychotherapy, and follow logically from grounding psychotherapy in complexity theory rather than through linear input-output-mechanisms. Nine criteria were outlined to illuminate the most pressing challenges facing professional psychotherapy, and which can be addressed through psychotherapy integration. We have argued that complexity science is able to provide the theoretical frame, as well as the technologies, to realize an integrative approach..

A prominent classification of routes to integration is outlined in the Handbook of Psychotherapy Integration (Norcross & Goldfried, 2005). The first route is called *common factors* and “seeks to determine the core ingredients that different therapies share in common” (Norcross, 2005, p. 9). The complexity approach as presented in our article is related to and acknowledges the rich body of findings on common, not treatment-specific factors (e.g., Duncan et al., 2010; Miller et al., 2005; Wampold & Imel, 2015), but beyond this, it stresses the importance of nonlinear interactions of all involved factors or variables which create the self-organized dynamics of any real therapy. To model and analyze the systemic constitution of psychotherapy, methods from complexity science are needed.

The second route to integration is technical eclecticism (Beutler et al., 2005; Lazarus, 2005) which is designed "to improve our ability to select the best treatment for the person and the problem … guided primarily by data on what has worked best for others in the past" (Norcross, 2005, p. 8). The complexity approach would agree but go beyond this by selecting treatments according to the client, the problem, and the specific moments of the concrete trajectory of change, e.g., periods of stability or instability or different degrees of synchronization. This route may be supported by using feedback technology like the SNS, which can help one to understand what’s going on at a particular point in treatment and inform the selection of techniques.

The third route is theoretical integration in which "two or more therapies are integrated in the hope that the result will be better than the constituent therapies alone" (Norcross, 2005, p. 8). Some models of theoretical integration focus on combining and synthesizing a small number of theories at a deep level, whereas others describe the relationship between several systems of psychotherapy (Arkowitz, 1989; Prochaska & DiClemente, 2005; Wachtel et al., 2005). The complexity approach can be subsumed under this aim of theoretical integration. It differentiates between a meta-theoretical frame (the first criterion of our list) and a concrete theory which should explain dynamics and outcome (second criterion). But theory alone is not sufficient. The practice of an *integrative and at the same time personalized* psychotherapy requires individualized case formulation and process feedback to guide the process.

Assimilative integration is the fourth route and acknowledges that most psychotherapists select a theoretical orientation that serves as their foundation but, with experience, incorporate ideas and strategies from other sources into their practice. "This mode of integration favors a firm grounding in any one system of psychotherapy, but with a willingness to incorporate or assimilate, in a considered fashion, perspectives or practices from other schools" (Messer, 1992, p. 151). By contrast complexity theory does not start from any psychotherapeutic school or orientation, but from a transdisciplinary scientific paradigm that has been successfully applied to complex patterns of change over time. This allows for the application of methods and findings from other fields to be applied to understanding psychotherapeutic change processes.

There are some other ways to integration as well, for example Russell and Breunlin’s (2019) Integrative Systemic Therapy which also takes a meta-theoretical perspective and refers to the management of systems complexity including clinical decision-making processes. However, this approach does not address the use of digitized process feedback, the application of existing theories of psychotherapy or procedures like case formulation. Another approach, Context-Responsive Psychotherapy Integration (Bugatti & Boswell, 2016; Constantino et al., 2013), tailors intervention principles to the needs of individual clients and offers an if-then framework that supports the utilization of evidence-based clinical strategies in response to the identification of specific process markers. It also tries to understand critical moments in the process of clinical decision-making. This is similar to our complexity science approach in its emphasis on timing, but is different in many other respects. Indeed, there are different kinds of overlap between the other psychological integration approaches and the complexity science approach developed here and time and progress will ideally select the most useful aspects of each.

One additional topic that was not in included in the nine criteria for integration we presented is the integration of psychological and brain-directed interventions. It may prove worthwhile for the field to invest more toward the combination of noninvasive methods of neuromodulation or neurostimulation and psychotherapy (e.g., de Charms et al., 2005; Fox et al., 2014; Tass & Popovych, 2012), particularly inasmuch as psychological treatments have the capacity to reorganize neuronal network dynamics (Schiepek et al., in press). It should be noted again that complexity science allows for the investigation and modelling of brain network dynamics and psychotherapy process using a common framework. Neuronal, mental, and social processes are based on different, but closely interwoven complex systems (Pincus & Metten, 2010). In consequence neurobiological mechanisms can be understood by means of complexity science and are not seen as a means of psychotherapy integration of its own.

The integrative approach which was presented in this article can be evaluated and should be evaluated in clinical routine practice – this is one of the criteria we proposed (standardized assessment of outcome). As empirical verification, and refinements, continue to accumulate, it will be equally important to integrate this approach in routine training programs for both scientists and practitioners. Ideally, a science that is focused explicitly on potentially complex processes of change over time, stability and flexibility, may provide an ideal grounding for clinicians who are similarly focused in their moment-to-moment interactions with their clients.

**Author Contributions**

Both authors, G.S. and D.P. contributed equally to the writing of the manuscript.

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Figure 1:(a)The structure of the model illustrates the dependencies between the variables E: emotions, a bi-dimensional variable representing dysphoric or positive emotional experiences; P: problem intensity and symptom severity; M: motivation for change; I: insight and new perspectives; S: success, therapeutic progress, and confidence in a successful therapy course. The functions of the relations are modulated by the control parameters (*a*) working alliance and capability to enter a trustful cooperation with the therapist, (*c*) cognitive competencies, mentalization, and emotion regulation, (*r*) behavioral resources and skills, and (*m*) dispositional motivation to change, self-efficacy, and reward expectation. The figure represents the 16 functions of the model. (b) The network of the system is represented by a matrix. The variables noted on the left of the matrix (lines) represent the input, the variables noted at the top (columns) represent the output. Each function is represented by a graph in a coordinate system (x-axis: input, y-axis: output). Green function graphs correspond to the maximum of the respective control parameter(s) (= 1), red graphs to the minimum of the parameter(s) (= 0). Blue graphs represent an in-between state (0 < parameter value < 1).

Figure 2:Order transition in the dynamics of the variable E (emotions). The y-axis refers to the values of the parameter *c* (0 < *c* < 1) and to the z-transformed values of E (-2.5 < E < 2.0). The transition of the pattern depends on a linear increase of *c* from 0.60 to 1.00 between iteration 100 and 200. From iteration 0 to 100 the parameter is kept constant at 0.60 creating a stable dynamic pattern (attractor). After the 200th iteration, *c* is constant at 1.00, producing another pattern at a lower mean level, at a lower frequency, and with higher amplitudes of the chaotic oscillations. The attractors are shown below the time series. During the increase of the control parameter, the transient attractor combines features of the attractor of the first sequence (1 to 100) and of the third sequence (200 to 300). In consequence, it is more complex than each of both.

Figure 3: Example of an idiographic system model which was developed together with a client (from Schiepek et al., 2015).

Figure 4: Complexity Resonance Diagram. The dynamic complexity of the time series of each item is calculated in an overlapping running window and is displayed by a rainbow color scale for each item (lines) of a process questionnaire (here: TPQ). The maximum score of the dynamic complexity is depicted by a full red pixel, while all other values are graded according to that maximum (red = high, yellow = medium, blue = low complexity). The order transition is marked by the arrow.

Figure 5: Recurrence Plot. The arrows show a short transient period (coded by yellow to red colors) between two more stable quasi-attractors.