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Review

Dynamical Systems Research (DSR) in Psychotherapy: A Comprehensive Review of Empirical Results and Their Clinical Implications

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Abstract: In psychotherapy research, the first applications of dynamical systems research (DSR) date back to the 1990s. Over time, DSR has developed three main lines of research: the study of oscillations in synchronization; the study of oscillations between stability and flexibility of process variables (S–F oscillations); the mathematical modeling to analyze the evolution of psychotherapy process. However, the connections among the empirical results and their implications for psychotherapy practice are unclear. For this reason, for the first time in the literature, this work carries out a comprehensive review of all three lines of research, including the main scientific contributions from the 1990s to the present day. For each line of research, the work critically analyzes the results, proposes future developments, and underlines the connections between empirical results and implications for psychotherapy practice. Furthermore, the work highlights the model of change that emerges from the empirical results, and its clinical correlates. In the conclusions, the author summarizes the results and the evolution of psychotherapy process in accordance with the DSR.

Keywords: psychotherapy research; dynamic systems; change process; process–outcome research; dynamics of change

Citation: Felice, G.d. Dynamical Systems Research (DSR) in Psychotherapy: A Comprehensive Review of Empirical Results and Their Clinical Implications. *Systems* **2024**, *12*, 54. https://doi.org/10.3390/systems12020054

Academic Editor: Wayne Wakeland

Received: 8 January 2024
Revised: 24 January 2024
Accepted: 2 February 2024
Published: 5 February 2024

1. Introduction

Scientific contributions based on a systemic approach within psychotherapy research have increased over time. A special section focused on dynamical systems research (DSR) has developed within the International Society for Psychotherapy Research. The scientific contributions within this framework have undoubtedly brought an important methodological advancement in the field. However, such contributions have often struggled to obtain full recognition within the broader landscape of psychotherapy research due to the difficulty in connecting the empirical results to their clinical implications. In short: DSR has often been perceived as a set of sophisticated mathematical methods devoid of any clinical relevance. The purpose of this work is to overcome this difficulty. In fact, this contribution constitutes the first comprehensive review on the topic, made with the aim of clarifying the connections between the empirical literature of DSR in psychotherapy and clinical practice.

DSR is not an exclusive line of research of psychotherapy but, rather, represents a general scientific advancement. In fields such as biology or medicine, for example, there are extensive discussions on the problem of the recent lack of new scientific discoveries. The problem of scientific reductionism has turned out to be the issue underlying the lack of new results in various branches of science [1]. In fact, until recently, the predominant idea was that the collective behavior of a complex system, regardless of its scientific domain, could be understood and predicted by studying the dynamics of all its subunits, considering each one in isolation. However, this approach of analysis proved to be insufficient when studying emerging behaviors, i.e., all the properties of the system arising from the interaction among its different internal components. Emergent properties highlight the need to focus scientific research on the most suitable level of abstraction, in such a way as to maximize the

variability of the scientific phenomena explained. Recent evidence of the importance of this topic is the contribution by Sadri [2], in which the author performed a manual systematic review of 32,000 articles from the last 150 years of scientific research in the field of drug discovery. The results clearly show the inadequacy of the current paradigm, which is based on a "target-based" approach that aims to search for molecules that directly modify the gene responsible for a pathology, in favor of a "phenotypic-based" approach, which prioritizes, in selecting and optimizing molecules, higher-level phenotypic observations that are closer to the sought-after therapeutic effects using tools based on a systems approach to science. In fact, phenotypic variability is not directly linked to single genes taken in isolation, but is determined by the emerging properties of complex genetic networks. Along this line, the most recent review of data on evolutionary processes highlighted the role of epigenetic factors and genetic networks, active during embryogenesis, in orchestrating variation-inducing phenomena underlying evolution, much more than the genome only [3]. With the transition from analyzing elements in isolation to complex networks, all the scientific literature based on the dynamic-systems approach develops.

In psychotherapy research, this fundamental transition, from studying a complex system by dividing it into simple components to the use of macro-parameters aimed at explaining the behavior of the entire system at hand, began in the 1990s. The first contributions belonging to DSR studied the applicability of self-organization principles to the psychotherapy process (e.g., [4,5]). Self-organization processes are a prerequisite for DSR, and they are particularly important for the introduction of the concept of circular causality on which the Palo Alto school of psychology also worked extensively [6]. In fact, the notion of self-organization emphasizes the process through which complex interactions between different elements of a system spontaneously generate a new property in the system itself. In clinical terms, with our patients we can sometimes talk about "family climate" to refer to that set of affective dynamics that have served as fertile ground for the formation of the patient's defensive strategies. In fact, often there is not a single event that produces psychopathology, but a set of conditions that resonate with a specific family member. Another synonym for self-organization is emergence. This term also underlines the lack of a single external agent responsible for the spontaneous generation of a new property of the system. In summary, spontaneity and the lack of a single external cause are the main characteristics of self-organization processes.

The applicability of DSR to psychotherapy has two main advantages. First, as in other sciences, it avoids scientific reductionism, which is particularly evident in the field of psychotherapy due to the multitude of different theoretical approaches. The concepts underlying DSR constitute a common fertile ground on which the clinical aspects, specific to each approach, can be developed. This ensures that research in psychotherapy can acquire a trans-theoretical and trans-disciplinary strength: that is, it can be enriched through scientific contributions coming from research based on different theoretical approaches and different scientific fields. Secondly, DSR promotes an empirical, methodological, and theoretical framework for the study of change within the psychotherapeutic process: Empirical, because the study of change within complex systems has produced a vast body of literature; methodological, because the methods used within the DSR are very innovative within psychotherapy research; theoretical, because the results of the literature have produced models of change that are studied within the psychotherapeutic process [7].

The importance of DSR for the study of change in the psychotherapy process is reflected in the lines of research that have developed over time: namely, the study of oscillations in synchronization; the study of oscillations between stability and flexibility of process variables (S–F oscillations); and the study of mathematical models to analyze the macro-parameters characterizing the psychotherapy process. These three lines of research represent the three main vertices of the study of change processes in psychotherapy and, importantly, they also represent the three chapters of this work. Three literature reviews were performed, one for each chapter. All contributions on DSR in psychotherapy were taken into consideration, therefore, from the 1990s to 2023. Within each section, the

work particularly focuses on the connections between empirical results and their clinical relevance. In detail, in the first part of each chapter, the status quo of the scientific literature is presented, while in the second part, the literature is critically analyzed, underlining significant future developments. Finally, in the conclusions, a general picture of the state of the art of DSR in psychotherapy is drawn, highlighting the research areas that have had the greatest development and those on which we need to focus our efforts the most.

2. Preliminary Requirements for Dynamical Systems Research (DSR)

There are two main requirements to set up a research work based on dynamical systems. The first refers to the length and frequency of the data time series. To monitor change processes within a time series, a homogeneous sampling frequency of data is needed. If possible, one measurement per day, or one every two days, should be taken. One measurement per session is also sufficient as long as the length of the time series is adequate: a minimum of about 40 time points. The second requirement refers to the choice of variables to analyze. To make DSR, the variables must be able to monitor change processes within psychotherapy. However, in this field, the problem of different therapeutic approaches arises, with their different language and corresponding different operationalizations of the variables probably being the most significant in supporting therapeutic change. For example, in a systematic review which ONLY considered the patients' characteristics that proved to be predictors of the outcome of cognitive-behavioural therapy (ONLY) for eating disorders (ONLY), the authors found 6 mediators, 13 moderators, and 20 predictors of outcome [8]. The review excluded any relational and therapist-related variables, as well as, obviously, any other therapeutic approaches and diagnoses.

In addition, nonindependent variables are increasingly included in moderation or mediation studies, violating the assumptions of statistical models based on analysis of variance [9]. The problem of nonindependence of process variables is particularly serious due to the nature of our clinical work. For example, both in empirical and clinical terms, it is absurd to consider variables of the therapeutic relationship as independent with respect to variables referring to the psychotherapeutic technique. Yet, it is enough to insert "mediation" as a keyword in one of the most accredited journals in the field of psychotherapy research to be able to observe how, for example, the "psychodynamic techniques", the "therapeutic alliance", and the "interpersonal and intrapersonal distress" can be considered constructs independent of each other, probably because the researchers measured those variables by using three different questionnaires. It is difficult to study the complex phenomenon of psychotherapy by reducing it into small independent components based on our need for simplification. This scientific reductionism, derived, on the one hand, from the theoretical–clinical fragmentation of psychotherapy and, on the other, from empirical oversimplification, produces a fragmented and sterile scientific corpus. How, then, do we choose the variables to analyze and avoid problems of scientific reductionism? It is of help to include second-order variables, abstracted from the original variables, in the study. We will see in the chapter on "stability–flexibility oscillations" (S–F oscillations) most of the parameters that can be measured starting from process variables, provided that the latter respect the frequency and length requirements mentioned above. These parameters, as the title of that chapter underlines, refer to two main dimensions: the stability and flexibility of the psychotherapeutic system. They lie at a higher level of abstraction than the original process variables. For example, seven subscales of a questionnaire can be correlated with each other, and the absolute values of the Pearson coefficients summed up. In this way, a score of stability or rigidity of the network made up of the seven subscales is obtained. This "stability score" is at a higher level of abstraction than the original process variables. Obtaining these parameters facilitates the comparison between results of different studies, avoids problems of scientific reductionism, and produces truly independent variables suitable for all types of models based on analysis of variance.

Years ago, we called this type of approach based on the abstraction of second-order parameters "A Statistical-Mechanics-Inspired Approach to Psychotherapy" to underline the

origins of this line of research [10,11]. In fact, statistical mechanics is the branch of physics that investigates the possibility of extracting a small number of relevant "macroscopic" parameters for the study of the mechanical and thermodynamic behavior of systems composed of a large number of particles.

3. Preliminary Concepts

As mentioned in the introduction, the study of the dynamics of change within the psychotherapy process constitutes the main focus of DSR. The key model of change on which the literature is based is the *order-to-order transition* (e.g., Schiepek et al., 1997, one of the first contributions on the topic) [12]. It is called order-to-order because it describes the transition from a stable dysfunctional state to a new stable state that is more functional than the previous one. The clinical work of psychotherapists is entirely focused on trying to promote, in the patient, a more functional psychic organization than that present at the time of the request for help. These transitions occur through moments of destabilization of the previous psychic organization. These moments of destabilization are often called *critical fluctuations*, and represent unstable states in which new patterns of feeling, thinking, and behaving (i.e., new information) are introduced into the patient–therapist relationship. This new information is then reintrojected in the patient as soon as he[1] obtains access to the new stable state. Therefore, the sequence characterizing order-to-order transitions is the following: (a) presence of a stable state or dysfunctional psychic organization; (b) entry into an unstable state of transition characterized by the inclusion of new patterns of feeling, thinking, and behaving in the therapeutic relationship; (c) emergence of a new and more functional stable state in which the new information is reintegrated into the patient. A given dysfunctional psychic organization is characterized by a level of anxiety directly proportional to the severity of psychopathology. The more severe the psychopathology, the higher the anxiety, and the greater the degree of distortion that the psychopathology produces to the reality perceived by the patient. Sometimes the literature uses the term "*attractor*" to identify the presence of a *stable state*. Although the two terms are very similar, there is a difference, in that the attractor can be made up of one or more stable states. For example, the oscillations between depressive-manic states generate the psychopathological attractor called bipolar disorder.

In accordance with the literature, the unstable state at point (B) is characterized by an increase in the correlation and variability of the system at hand (Figure 1) (see Gorban et al., 2021 for a review) [13].

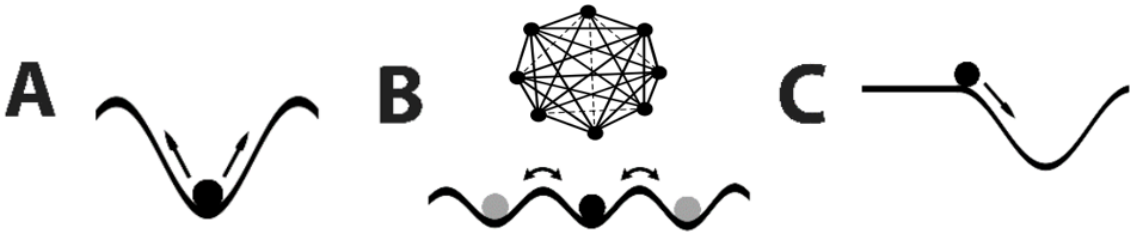

Figure 1. Dynamics of change according to DSR. (**A**) Patient in current stable dysfunctional state. (**B**) Patient-system opening up. Increase in correlation and variability. (**C**) New information reintegrated and patient-system in a more functional stable state. Decrease in variability and presence of new correlations, different from those characterizing the initial state. Parts of the figure are taken from Olthof and colleagues [14].

At point (A), the patient-system resides in the current stable dysfunctional state. At point (B), it opens up to new patterns of feeling, thinking, and behaving. At point (C), the new information is reintegrated and it resides in a more functional stable state than the initial one.

As can be seen in the figure, point (B) is characterized by two different aspects. Increase in correlation, upper panel: the patient's narratives acquire coherence, the core problematic

theme emerges with ever greater clarity, the same dysfunctional relational modality permeates the different domains of the patient's life (professional, emotional, familial). The patient's current psychic organization becomes more integrated and correlated with other aspects of his functioning. This greater understanding of the patient's functioning allows him to lighten the burden of anxiety associated with the current stable dysfunctional state. This allows the patient greater openness towards new patterns of feeling, thinking, and behaving. Increase in variability: in the bottom panel, the possible valleys that could host the ball multiply, that is, the variability of the patient's narratives increases, laying the foundations for a change that will occur in (C).

The stable states at point (C) can be of two types. They may be structurally the same as the previously dysfunctional state, but present less distress, or they may be structurally different from the previous stable dysfunctional state. In the first case, we are faced with a *first-order change*; in the second case, we are faced with a *second-order change* [15]. An example of the former is the patient who resolves his phobic symptom and manages to board the plane, or enter the elevator, or participate in gatherings with many people. An example of the latter is the patient who manages to restructure the phobic organization of his personality. First-order changes are more frequent and involve the patient's body of *knowledge*, whereas second-order changes are rarer, as they imply a general restructuring of the current psychic organization (i.e., the way of *being* of the patient).

The process of psychotherapy is a catalyst for first- and second-order changes with the final aim of promoting, within the patient, the ability to come into contact and experience a highly diversified range of relational modalities. In fact, the patient who begins psychotherapy presents a rigid and repetitive way of experiencing the relationships that surround him. As the therapeutic relationship progresses, the patient gradually obtains access to an increasingly wider range of relational modalities (e.g., [16,17]). The patient is healthy when he is courageous enough to feel happiness, sadness, desperation, physical and mental pain, tenderness, light-heartedness, and the other emotional colors that make life worth living. Order-to-order transitions, stable states and attractors, unstable states and critical fluctuations, first-order changes, and second-order changes are the basic notions allowing a full understanding of the empirical and clinical depth of the research presented below.

4. High–Low Synchronization

Studies on synchronization in psychotherapy mainly include three areas: the study of physiological synchronization between patient and therapist, measured mainly through skin conductance, ECG, EEG, fMRI (see Kleinbub et al., 2020 for a review) [18]; the study of nonverbal synchronization, measured mainly through postural and gaze movements of patient and therapist (see Koole and Tschacher, 2016 for a review) [19]; and the study of verbal synchronization, measured mainly through the prosodic elements of language (e.g., see Orsucci et al., 2016; Scheidt et al., 2021 for a review) [20,21]. Initially, findings in the literature from these three areas supported a simple equation: the higher the synchronization among patient and therapist, the better the psychotherapy outcome. This simple model also seemed to be supported by the results of studies that established a linear positive correlation between therapeutic alliance and synchronization (see the work by Koole and Tschacher for a review). Therefore, from this perspective, high synchronization between patient and therapist was associated with a good therapeutic alliance, which in turn was responsible for the successful outcome of psychotherapy. It is not known what the therapist should do in this model once a good therapeutic alliance has been established. However, as research on this topic progressed, much conflicting evidence emerged. For example, higher synchronization has been observed in poor-outcome dyads, and interpreted as the therapist's struggle to promote the good development of therapy (e.g., [22]). Current studies show how high synchronization is not always associated with the good development of a therapeutic relationship. In fact, a more accurate hypothesis is grounded on the idea that

two tendencies exist simultaneously, one to synchronize with others and the other to move out of synchrony and act independently (see Mayo and Gordon, 2020 for a review) [23].

From a clinical perspective, the model based on the linear association between high synchronization and good outcome of therapy due to good therapeutic alliance is unsound. The psychotherapy process develops if new information and points of view are introduced, often unexpectedly for the patients, producing moments of rupture and repair of the therapeutic alliance (e.g., [24]), and, more likely, moments of rupture and repair of synchronization. It is for this reason that the literature on synchronization acquires clinical depth if applied to the understanding of the dynamics of change within the psychotherapy process, i.e., to investigate how new information is processed within the therapeutic dyad. There are two particularly brilliant examples in the literature on this topic. The first, in chronological order, is by Villmann and colleagues [25], and focuses on the relationship between the physiological entropy of patient and therapist and the language used by the patient within a 37-session psychodynamic psychotherapy. Specifically, the authors highlight how, in the period in which the patient processes new information ("connecting phase", high abstract language, and high emotional language), the physiological entropy of patient and therapist is high. Subsequently, the patient reintegrates the new information, moving to the "reflecting phase", characterized by high abstract language, low emotional language, and low physiological entropy. Since entropy is a measure of variability, the results suggest an "opening" of the therapeutic dyad towards new information coming from the "connecting phase", followed by a reintegration of these novelties within a new point of view (i.e., new stable state). The entire oscillation can be summarized as follows: (a) Flexibility phase, in which entropy is high, emotional language is high, a new perspective is entering within the psychotherapeutic relation; (b) Stability phase, in which entropy is low, emotional language is low, abstract language is high, the new perspective is worked through until it is fully integrated. In this study, the analysis of synchronization of physiological variability plays a vital role in the understanding of the characteristics of this change dynamic. A further example comes from the work by Stukenbrock and colleagues [26], which focuses on gaze synchronization in moments when therapists deliver interpretations to patients. Fifty sessions of two different therapeutic dyads were analyzed. The results clearly show how therapists look away from their patients during the interpretation, recovering eye contact only when the most audacious content of the interpretation is made explicit. Hence, the initial distance (gaze avoidance) is used by the therapist to "grasp" the new information to introduce it into the therapeutic process, finding the most suitable words and modality of delivery. The following proximity (recovery of eye contact) is used to observe the patient's reaction to the new content previously expressed. The study of low–high synchronization oscillations, in relation to the dynamics of processing the new contents conveyed by the interpretation, produces extremely relevant clinical results. It would be interesting to delve deeper into this line of research by analyzing the dynamics of successful and unsuccessful interpretations separately; in other words, interpretations whose emotional content is subsequently reintegrated or rejected by the patient.

Finally, another rather forgotten application of physiological measurements within psychotherapeutic sessions is associated with the patient's anxiety. The patient's physiological arousal, being an expression of the activity of the sympathetic branch of the autonomic nervous system, constitutes an efficient thermometer of the patient's internal anxiety. This application of physiological measures in psychotherapy is potentially very clinically relevant, and should certainly be developed more. For example, it could be studied in relation to the interpretations reintegrated or rejected by the patient. In this case, the hypothesis could be that an emotional content causing too much internal anxiety is rejected by the patient. On the other hand, with a more macro-analytical design, it could be studied in relation to first- and second-order change processes to identify when the level of internal anxiety prevents such changes, i.e., when it prevents the reintegration of new information.

5. Stability–Flexibility Oscillations

5.1. Macro-Parameters

The definition of macro-parameters is not the most common in the literature on this topic. In fact, most contributions use the term "early warning signals". In practice, there is no difference; both terms identify a set of parameters measured on a time series with the aim of studying their changes over time. However, there is a substantial conceptual difference at the root of the two terms. The majority of contributions in the literature on early warning signals applied to psychology study their applicability in predicting or anticipating a transition of the patient's symptoms (see Schiepek et al., 2020 for a review of methods in psychotherapy research; Helmich et al., 2021; Dablander et al., 2023 for a general review in psychology) [27–29]. In fact, the term "early warning signals" precisely indicates this purpose; to have parameters whose increase identifies a transition in the time series of symptoms. This scientific perspective, although important, is not the one with the greatest clinical implications for the study of change within psychotherapy. On the other hand, the use of the term "macro-parameters" does not convey any exclusive application of these indices in relation to the possible transition of symptoms; rather, it promotes a broader application: to the study of oscillations between stability and flexibility within psychotherapy and to their relationship with first- and second-order change (e.g., [30,31]). The clinical importance of this last topic overshadows the question of the association between the increase in these parameters and the possible transition of symptoms. Clinically, it is more important to understand the ingredients that promote and prevent a symptomatic change regardless of whether or not the latter can be included in the category of "phase transitions", or even in a specific subset of phase transitions (e.g., "zero-eigenvalue bifurcations"; see, for example, the work by Dablander and colleagues).

Therefore, what are these parameters? The literature highlights two large groups of indices: the first quantifies the degree of stability or rigidity, while the second the degree of flexibility or dispersion. To date there are few studies comparing the majority of indices within psychotherapy process (see, for example, the work by de Felice and colleagues, 2019b, 2022) [10,31]. However, two renowned research groups focus on specific indices. The research group of Prof. Schiepek has been studying the application of "dynamic complexity", an index of dispersion of a time series, for many years (e.g., [32,33]). The research group of Prof. Lichtwarck-Aschoff and Dr. Olthof have more recently focused their efforts on the application of autocorrelation at lag-1, an index of time series memory to which we will return shortly (e.g., [34]). Schematically:

- *Indices that quantify stability or rigidity*. The most used are the sum of Pearson coefficients in absolute value, calculated on each pair of process variables; the percentage of variance explained by the first principal component (see Gorban and colleagues for a review). If applied within a network, they are called connectivity indices as they measure the strength of connections within the network. Clinically, we can associate the increase in these indices with an increase in coherence of the patient's narratives. In fact, as psychotherapy progresses, we can observe how the patient's dysfunctional relational pattern becomes similar in the different domains of his life: professional, emotional, and familial. Achieving such a high coherence of the patient's narratives allows the therapist to intervene to promote the emergence of a new and more functional psychic organization.
- *Indices that quantify flexibility or dispersion*. The most used are dynamic complexity, obtained by multiplying the fluctuation and distribution of the scores of process variables; the standard deviation, a classic measure of dispersion of the scores of a time series; the Shannon entropy, often applied on eigenvalues (see de Felice and colleagues, and Gorban and colleagues for a review). Clinically, we can associate these indices with the variability of the patient's narratives. Often, in the moment before a change, the patient does completely new things such as looking at old photographs from his childhood, asking his family members things he had never talked about before, organizing his life differently, with new hobbies and new relationships whose diversity

he previously would not have been able to manage. The oscillation between periods of high and low stability and flexibility (i.e., S–F oscillations) in the psychotherapy process promotes the good outcome of treatment (see Section 5.2).

It is necessary to address a separate discussion for the *lagged autocorrelation*. This is a time series memory index. In other words, it measures how similar the relationships between the nodes of a network at time t are to the relationships between the nodes of the same network at a previous time point (e.g., [35]). In the case the comparison is among time t and time t-1, it is defined autocorrelation at lag-1; in the case the comparison is among time t and time t-2, it is defined autocorrelation at lag-2, and so on. The clinical meaning of this index is similar to that of the stability indices, with the addition of the temporal dimension. As psychotherapy progresses, the patient's narratives acquire internal coherence, allowing the main problematic theme to emerge. The latter becomes increasingly present in sessions and often repeats itself between one session and the next. Therefore, the correlation between the patient's narratives at the session at time t and the session at time t-1 (i.e., the previous session) increases. This redundancy of the main problematic theme often increases until, together with the therapist, a way is found to include a new perspective within the therapeutic relationship. The introduction of new information (i.e., new patterns of feeling, thinking, and behaving) generates space in the patient's mind, giving greater variability to the therapeutic relationship.

In the empirical literature, the increase in autocorrelation at lag-1 has often been interpreted as an index of loss of resilience (see, for example, Dablander and colleagues). This interpretation, completely detached from psychotherapeutic practice, is misleading. To understand the rationale of the empirical perspective, it is useful to replace point (B) of Figure 1 with Figure 2.

Figure 2. Illustration of the role of autocorrelation within order-to-order transitions in accordance with the empirical perspective. The reader should replace point (B) of Figure 1 with point (B1). In the initial state, the system is healthy and resilient. At point (B1), the system lies in a shallower valley, losing resilience. The system ends up lying in a dysfunctional state, causing the onset of psychopathology.

In Figure 2, we see that the ball (i.e., the system studied) lies in a shallower valley than at point (A) of Figure 1. This change of depth is interpreted as a loss of resilience. In fact, from this perspective, the system is healthy and resilient at point (A) as it is more resistant to external stressors (i.e., a greater force must be applied to move the ball out of the deeper valley). Conversely, at point (B1), the external stressors must apply a smaller force as the valley is shallower. This loss of resilience is identified with the increase in the autocorrelation at lag-1, as the system at point (B1) takes longer to dissipate the external stressor and return to its stable state at the center of the valley. The process ends at point (C), which the empirical literature interprets as the onset of the pathology of the observed system. This type of change process, deriving from other scientific fields (see the work by Scheffer and colleagues), does not agree with the specific reality of the clinical progress of psychotherapy. The patient who begins psychotherapy tends to be unwell and wants to achieve better health. Furthermore, resilience in clinical terms is related with the concept of stability, as underlined by the empirical perspective, but it is also associated with the patient's flexibility (see, for example, the work by Lingiardi and McWilliams). The acquisition of psychic flexibility helps the patient to be able to manage new relational experiences without perceiving them as stressors. In other words, the resilient patient possesses, on the one hand, a stable self-coherence and, on the other

hand, has the ability to experience a wide range of different relational modalities. If the concept of flexibility were not included in the definition of resilience, we would observe the paradox of the patient who never ends up in a psychopathological condition as he has such a rigid relational modality that he avoids any external stimulus that does not match his expectations. It is clear that in this case stability becomes rigidity, and the patient's mind is not at all resilient but, rather, impoverished. Therefore, in accordance with clinical practice, researchers studying resilience in psychotherapy should relate the concept to both dimensions of stability and flexibility of the patient. We see once again how central the study of S–F oscillations in DSR is.

We presented indices that quantify the stability or rigidity, flexibility or dispersion, and memory or redundancy of the psychotherapeutic system. The reader has perhaps already noticed the main lack exposed in the literature: the measures of quality of change. All the macro-parameters presented are excellent quantitative resources, but when we want to investigate the quality of change within psychotherapeutic process, it seems we have no major alternatives to the analysis of clinical transcripts. The analysis of clinical transcripts should not be taken lightly. Certainly, the literature abounds with possible codings based on the variables that a given research group considers to be the most relevant to analyze the clinical transcript (see Mergenthaler, 2008 on Therapeutic Cycle Model; Caro Gabalda and Stiles, 2021 on Assimilation of Problematic Experiences Scale for two well-established methods) [36,37]. For example, the coding of the Therapeutic Cycle Model is based on the segmentation of clinical transcript into subsequent word-blocks of 150-word length, coded in terms of "abstract language", "positive emotional language", and "negative emotional language". However, we are still far from developing a scientific consensus on an agile and efficient method of automatic coding of clinical transcripts able to abstract the most relevant clinical dimensions. Mainly, this is because the clinical dimensions derive from the transcript but are latent, that is, they represent a subtext that is generated by the specific encounter between the patient and therapist's subjectivities. However, the efforts of some research groups are commendable: the research group of Prof. Salvatore and Prof. Gelo developed the Automated Co-occurrence Analysis for Semantic Mapping (ACASM) [38], a method that is able to transform a clinical transcript into a network of recurrent clusters of words; Christensen and colleagues developed an automatic tool for semantic network analysis [39]; the research groups of Prof. Mergenthaler and Prof. Bucci developed two different automatic tools to analyze clinical transcripts with a focus on the evolution of abstract and emotional language within psychotherapy (e.g., Mergenthaler, 2008 on Therapeutic Cycle Model; Christian et al., 2021, on Referential Activity) [36,40].

While the analysis of clinical transcripts is certainly very important to compare with the performance of quantitative indices, the literature offers a further alternative to monitor the quality of change, which is yet unknown in psychotherapy research. The time series of process variables considered in a given research design can be investigated with a sliding window principal component analysis. This approach allows the researcher to observe the evolution of the loadings within the first (PC1) and second (PC2) principal components over time (see Zimatore et al., 2021 for an example in biophysics) [41]. In fact, a change in PC1 loadings reflects a change in the quality of the current stable state. On the other hand, it is possible to consider PC2 as an "entropic reservoir", that is, as a reservoir of new information that the good-outcome patient, over the course of treatment, is able to integrate into the current stable state (PC1), causing its modification. This is why the study of S–F oscillations is so important. The concept of flexibility (PC2) is linked with the ability to reintegrate new and more functional information within the current stable state (PC1). Having both a stable and flexible component seems to be an evolutionary characteristic selected in order to obtain a good dynamic stability (e.g., [42,43]). In summary, the researcher can monitor the quality of change through a comparison of macro-parameters with clinical transcripts, as well as by looking at the evolution of the loadings of a sliding window principal component analysis applied over process variables.

5.2. S–F Oscillations

The oscillations between stability and flexibility of process variables constitute the main focus of DSR. During periods of flexibility the psychotherapeutic system is able to come into contact with new patterns of feeling, thinking, and behaving, which can then be reintegrated into the patient, causing the modification of the previous dysfunctional stable state. The cycle terminates with achieving a new and more functional stability. We list the corpus of literature on this topic below.

One of the first studies on this subject investigates the patterns of interactions among therapist and patient of a single case of psychodynamic psychotherapy lasting 32 weeks. The results highlight stable and unstable nodes within the network of therapist–patient interaction [44]. The study of episodes of pronounced destabilization leading to a loosening of old patterns has proven to be a characteristic of good-outcome psychotherapies (see Hayes et al., 2007 for a review, including personality disorders and mood disorders) [45]. The investigation of clinical transcripts relating to a single case of emotion-focused therapy using discourse flow analysis highlighted a two-step process of change: a decrease in semantic variability in the first part of treatment, then an increase in semantic variability in the second part of treatment [46]. The alternation of periods of high and low destabilization of patient–therapist relationship characterized the process of psychodynamic psychotherapy in a sample of 15 inpatient treatments for mood and personality disorder. Additionally, a high correlation among patient and therapist destabilization processes has been observed in good-outcome cases only [47]. In seven patients suffering from obsessive-compulsive disorder with predominantly checking symptoms, the process variables "beliefs", "anxiety", and "compulsions" were characterized by periods of high and low correlation in cognitive-behavioral therapy [48].

By using the Innovative Moments Coding System (IMCS) to describe the process of change in narrative therapy (NT), emotion-focused therapy (EFT), and client-centered therapy (CCT), Prof. Gonçalves and colleagues revealed that the overall number of innovative moments (i.e., variability) is significantly associated with symptom improvement. In addition, they proposed a heuristic model of change based on the alternation of a period of innovation (i.e., increase in variability) followed by the reintegration of novelties (i.e., increase in stability) [49]. In detail, the period of innovation is characterized by an alternation among narratives pertaining to the dysfunctional stable state and narratives pertaining to the new and more functional organization [50].

In 27 patients diagnosed with avoidant or obsessive-compulsive personality disorder, destabilization, and emotional processing during the central phase of cognitive therapy were both significant predictors of the good outcome of treatment [51].

The research group led by Prof. Schiepek has been applying a daily monitoring procedure to inpatient treatments in Austria and Germany for several years. Every day, patients must complete the Therapeutic Process Questionnaire (TPQ), a questionnaire monitoring seven process variables: "well-being and positive emotions", "relationship with fellow patients", "therapeutic alliance and clinical setting", "emotional and problem intensity", "insight/confidence/therapeutic progress", "motivation for change", and "mindfulness/self-care". In addition, outcome questionnaires are administered to evaluate symptomatic change. Over the years, a remarkable database has been collected. Some ongoing studies include hundreds of psychotherapies. The published articles revealed the presence of periods of destabilization characterized by high variability followed by its reduction, particularly in good-outcome cases (see Schiepek et al., 2003 with a sample of 91 inpatient treatments; Schiepek et al., 2014 with a sample of 23 patients with obsessive-compulsive disorder; Heinzel et al., 2014 with a sample of 18 patients with obsessive-compulsive disorder) [52–54].

The macro-parameters of order and flexibility proved to be efficient indicators in describing the evolution of 28 psychotherapies, 14 good-outcome, and 14 poor-outcome cases. In detail, cycles of high order and high flexibility characterized the successful cases (see de Felice et al., 2019b; de Felice et al., 2022) [10,31]. Furthermore, the

alternation between stable and unstable states was also highlighted in four child psychotherapies [55,56].

A questionnaire on the psychotherapeutic process was administered daily in 328 patients who received psychotherapy for mood disorders. A continuous measure of destabilization was defined as the relative strength of the highest peak in dynamic complexity. The presence of periods of destabilization and, therefore, the alternation between stable and unstable states was found to be related to a better treatment outcome (see Olthof et al., 2020) [34].

Finally, the study of clinical transcripts through the Therapeutic Cycle Model and Referential Activity revealed the presence of specific cycles in good-outcome cases. In detail, these cycles were constituted by an alternation of phases characterized by high emotional language in which the patient expressed the current dysfunctional pattern of feeling, thinking, and behaving, and phases characterized by a copresence of emotional language and abstract language in which the patient reflected on that dysfunctional organization (i.e., self-reflection) (see Mergenthaler, 2008 for a review on the Therapeutic Cycle Model; Cornell and Bucci, 2020 for a review on referential activity) [36,57].

These results, taken together, clearly show the robust body of literature on S–F oscillations. It would be very significant, through multilevel studies, to compare the temporal evolution of:

- High and low physiological or bodily synchronization;
- S–F oscillations of relational process variables;
- Cycles of emotional and abstract language and their semantic contents;

With the objective of highlighting the ingredients promoting and impeding first- and second-order changes in the psychotherapy process.

6. Mathematical Modeling

In this section, differential equation models based on empirical data from psychotherapy research are considered. Completely theoretical models without an empirical connection or based on data from other sources are excluded.

In a study with a sample of 180 psychotherapies (with an average of 29 sessions per psychotherapy), the "Working Alliance Inventory-Short Revised" questionnaire was filled out by the patient and the therapist at the end of each session [58]. The authors used a differential equation model based on the scores of the patient and therapist at session at time t and at session at time t + 1 and their rates of change. The parameters reflected the stability of the scores between session t and session t + 1 (i.e., internal consistency), and the levels to Ih one's perception influenced, and was influenced by the other's perception. Contrasting results do not allow a reliable interpretation.

Paz and colleagues analyzed the vocal arousal (i.e., speech sound frequencies) of 30 dyads, using as parameters the vocal arousal scores of the patient and therapist at state t and at state t + 1 and their rates of change [59]. The results showed the presence of an intrapersonal and an interpersonal homeostasis. In particular, (a) the patient's scores, in the first part of the treatment, tended to be "pulled" towards the therapist's baseline (interpersonal homeostasis), and (b) the patient's scores, in the second part of the treatment, tended to return to his baseline levels (intrapersonal homeostasis).

Taken together, the results highlight the importance of preverbal coregulatory processes. It would be important to replicate this type of model on relational variables or on the semantic content of language.

Tschacher and Haken proposed a mathematical model based on the Fokker–Planck equation in order to identify the deterministic (i.e., stability) and stochastic (i.e., flexibility) component of one or more time series within the psychotherapy process [60]. The method was tested in a case series where client's and therapist's heart rate, heart rate variability, and respiration were monitored in 20 psychotherapy sessions. The authors also developed an app (FPE app) for automatic calculation. This methodology requires high-resolution time series, such as those derived from physiological variables. The results confirm the

applicability of the Fokker–Planck equation in identifying stable and unstable states within the physiological time series recorded over the course of the psychotherapy process.

Schiepek and colleagues worked on a mathematical model based on the Therapeutic Process Questionnaire (TPQ) factors, the instrument used by this research group for the daily monitoring of inpatient treatments. In fact, the model variables are (E) emotions; (P) problem intensity, symptom severity; (M) motivation to change; (I) insights; (S) success, therapeutic progress, confidence in a successful therapy course. On the other hand, the four parameters that govern the relationships between the variables are (a) working alliance, capability to enter a trustful cooperation with the therapist; (c) cognitive competencies, capacities for mentalization and emotion regulation; (r) behavioral resources or skills which can be applied to problem-solving; (m) self-efficacy, positive expectations in one's development. Five coupled nonlinear equations, one for each variable, describe the behavior of the variables in relation to the selected parameters [61,62]. As can be seen from the brief description, this is the most sophisticated model in mathematical terms. Yet, there is no comparison with the complexity of clinical reality, which is greatly simplified through these equations. Five variables and four parameters certainly cannot represent the personality of a patient. But, precisely, the awareness of this simplification highlights the importance of the efforts of this research group. The simulations of the model give rise to temporal dynamics characterized by attractors, alternation between stable and unstable states, critical transitions, and order-to-order transitions, all of which are typical phenomena of the change model proposed by DSR. Therefore, if such a simplified model generates a typical evolution of a dynamic system, we must assume that DSR is the most appropriate perspective for the study of the psychotherapy process.

It would be interesting to use the models by Paz and colleagues and Schiepek and colleagues to study the evolution of the macro-parameters of therapy process. In this way, the temporal dynamics of stability and flexibility could be explored in relation to first- and second-order changes. The model proposed by Tschacher and Haken based on the Fokker–Planck equation is highly relevant because it generates stability and flexibility measures as output. However, its application is limited to high-resolution time series, pertaining to physiological variables only. It would be remarkable if a similar model could be developed for lower-resolution time series, such as those derived from daily questionnaires or from linguistic variables measured on consecutive text segments.

7. Conclusions and Future Directions

This work carries out a comprehensive review of DSR in psychotherapy, from the 1990s to the present day. In the first section, the results of research on oscillations of physiological and nonverbal synchronization between patient and therapist were presented. This area of research is relevant because it investigates the processes of preverbal affective coregulation. The patient–therapist relationship is not exclusively governed by shared cognitive objectives but is, above all, a relational experience between two bodily subjectivities. Often, in our patients, we observe a discrepancy between the bodily and cognitive processing of an experience, and we consider the realignment of these two aspects a necessary ingredient for the patient's health (e.g., Lingiardi and McWilliams, 2017; Cornell and Bucci, 2020) [17,57]. Therefore, investigating the processes of preverbal affective coregulation becomes clinically very relevant if placed in relation to the patient's first- and second-order changes. In the second section, the results of the research on S–F oscillations of process variables were presented. The study of the evolution of stability and flexibility within the psychotherapy process is clinically very significant. In moments of high flexibility, the patient comes into contact with new patterns of feeling, thinking, and behaving; in moments of high stability, these patterns are reintegrated in the patient. Hence, this area of research directly investigates change processes. In the third section, the results of mathematical modeling were presented. In this area, the most clinically meaningful aspect lies in the contrast between the clinical simplification presented by these models, and the complexity of the results obtained through simulations (see, for example, Schiepek et al., 2017) [61]. Given

that such clinical simplification shows a psychotherapy process characterized by all those elements typical of dynamic systems, it follows that DSR constitutes the most suitable research framework for its investigation.

According to such a perspective, psychotherapy is a relational field into which a new patient enters. The latter presents rigid and dysfunctional relational models. With the help of the therapist, the patient acquires stability and flexibility. Stability because he becomes aware of his own functioning. Flexibility, because he comes into contact with new relational models. The increase in stability and flexibility promotes the patient's first- and second-order change. At the end of a successful psychotherapy, the patient's functioning (i.e., his phase space) has a stable area, which represents his basic personality, and a flexible area, which represents his ability to live new experiences and exchange new information with the environment. We can imagine the good-outcome patient's network as made up of a group of central nodes with stable edges, and a group of peripheral nodes with flexible edges. The peripheral nodes allow the network to come into contact with new information generated by the patient–environment interaction. Some of these can modify the group of stable central nodes (basic personality); others dissipate at the periphery of the network. A good balance in these two areas of the patient's network constitutes his good dynamic stability. There is still certainly a lot of empirical evidence to be obtained to fully support this model of change promoted by the DSR. The intriguing aspect is that the network of the good-outcome patient hypothesized here resembles the structure of the complex macromolecules central to cellular function and central for life: proteins. In fact, together with a stable native structure, they exploit intrinsically disordered segments in order to exchange information and modify their functions (see Keul et al., 2018; Henzler-Wildman et al., 2007; Malaney et al., 2013) [42,63,64]. Therefore, it seems that, for adaptive purposes, nature selects the copresence of stability and flexibility within a given organism to promote its dynamic stability. Researchers dealing with DSR in psychotherapy will not remain unemployed in the coming decades: evaluating the model of change proposed here and its possible transdisciplinary connections will keep us at our desks for quite some time yet.

Funding: This research received no external funding.

Data Availability Statement: Data are available: data supporting the findings and conclusions are available upon request from corresponding author.

Acknowledgments: I am deeply grateful to my friend, Alessandro. This article is dedicated to all our research efforts over these years.

Conflicts of Interest: The authors declare no conflicts of interest.

Notes

[1] In this article, the author only uses the masculine pronoun to refer to the patient to make reading easier. It is intended that in each sentence the pronoun encompasses any gender.

References

1. Giuliani, A. Why systems biology can promote a new way of thinking. *Syst. Synth. Biol.* **2015**, 25–41. [CrossRef]
2. Sadri, A. Is Target-Based Drug Discovery Efficient? Discovery and "Off-Target" Mechanisms of All Drugs. *J. Med. Chem.* **2023**, *66*, 12651–12677. [CrossRef] [PubMed]
3. Spadafora, C. The epigenetic basis of evolution. *Prog. Biophys. Mol. Biol.* **2023**, *178*, 57–69. [CrossRef] [PubMed]
4. Schiepek, G.; Fricke, B.; Kaimer, P. Synergetics of psychotherapy. In *Self-Organization and Clinical Psychology: Empirical Approaches to Synergetics in Psychology*; Springer: Berlin/Heidelberg, Germany, 1992; pp. 239–267.
5. Schiepek, G.; Tschacher, W. Application of synergetics to clinical psychology. In *Self-Organization and Clinical Psychology: Empirical Approaches to Synergetics in Psychology*; Springer: Berlin/Heidelberg, Germany, 1992; pp. 3–31.
6. Watzlawick, P. (Ed.) *The Invented Reality: How Do We Know What We Believe We Know?* W. W. Norton & Company: London, UK, 1984.
7. Gelo, O.C.G.; Salvatore, S. A dynamic systems approach to psychotherapy: A meta-theoretical framework for explaining psychotherapy change processes. *J. Couns. Psychol.* **2016**, *63*, 379–395. [CrossRef] [PubMed]

8. Linardon, J.; de la Piedad Garcia, X.; Brennan, L. Predictors, moderators, and mediators of treatment outcome following manualised cognitive-behavioural therapy for eating disorders: A systematic review. *Eur. Eat. Disord. Rev.* **2017**, *25*, 3–12. [CrossRef]
9. de Felice, G.; Giuliani, A.; Halfon, S.; Andreassi, S.; Paoloni, G.; Orsucci, F.F. The misleading Dodo Bird verdict. How much of the outcome variance is explained by common and specific factors? *New Ideas Psychol.* **2019**, *54*, 50–55. [CrossRef]
10. de Felice, G.; Orsucci, F.F.; Scozzari, A.; Gelo, O.; Serafini, G.; Andreassi, S.; Vegni, N.; Paoloni, G.; Lagetto, G.; Mergenthaler, E.; et al. What differentiates poor and good outcome psychotherapy? A statistical-mechanics-inspired approach to psychotherapy research. *Systems* **2019**, *7*, 22. [CrossRef]
11. de Felice, G.; Giuliani, A.; Gelo, O.C.; Mergenthaler, E.; De Smet, M.M.; Meganck, R.; Paoloni, G.; Andreassi, S.; Schiepek, G.K.; Scozzari, A.; et al. What differentiates poor-and good-outcome psychotherapy? a statistical-mechanics-inspired approach to psychotherapy research, part two: Network analyses. *Front. Psychol.* **2020**, *11*, 788. [CrossRef]
12. Schiepek, G.; Kowalik, Z.; Schütz, A.; Köhler, M.; Richter, K.; Strunk, G.; Mühlnickel, W.; Elbert, T. Psychotherapy as a chaotic process I. Coding the client-therapist interaction by means of Sequential Plan Analysis and the search for chaos: A stationary approach. *Psychother. Res.* **1997**, *7*, 173–194. [CrossRef]
13. Gorban, A.N.; Tyukina, T.A.; Pokidysheva, L.I.; Smirnova, E.V. Dynamic and thermodynamic models of adaptation. *Phys. Life Rev.* **2021**, *37*, 17–64. [CrossRef]
14. Olthof, M.; Hasselman, F.; Oude Maatman, F.; Bosman, A.M.; Lichtwarck-Aschoff, A. Complexity theory of psychopathology. *J. Psychopathol. Clin. Sci.* **2023**, *132*, 314. [PubMed]
15. Greenberg, L.S. Integrating an emotion-focused approach to treatment into psychotherapy integration. *J. Psychother. Integr.* **2002**, *12*, 154. [CrossRef]
16. Stern, D.B. Comments on the clinical material presented by Jill Scharff. *Psychoanal. Inq.* **2001**, *21*, 499–507. [CrossRef]
17. Lingiardi, V.; McWilliams, N. (Eds.) *Psychodynamic Diagnostic Manual: PDM-2*; Guilford Publications: New York, NY, USA, 2017.
18. Kleinbub, J.R.; Talia, A.; Palmieri, A. Physiological synchronization in the clinical process: A research primer. *J. Couns. Psychol.* **2020**, *67*, 420. [CrossRef] [PubMed]
19. Koole, S.L.; Tschacher, W. Synchrony in psychotherapy: A review and an integrative framework for the therapeutic alliance. *Front. Psychol.* **2016**, *7*, 862. [CrossRef]
20. Orsucci, F.F.; Musmeci, N.; Aas, B.; Schiepek, G.; Reda, M.A.; Canestri, L.; Giuliani, A.; De Felice, G. Synchronization analysis of language and physiology in human dyads. *Nonlinear Dyn. Psychol. Life Sci.* **2016**, *20*, 167–191.
21. Scheidt, C.E.; Pfänder, S.; Ballati, A.; Schmidt, S.; Lahmann, C. Language and movement synchronization in dyadic psychotherapeutic interaction–a qualitative review and a proposal for a classification. *Front. Psychol.* **2021**, *12*, 696448. [CrossRef] [PubMed]
22. Paulick, J.; Deisenhofer, A.K.; Ramseyer, F.; Tschacher, W.; Boyle, K.; Rubel, J.; Lutz, W. Nonverbal synchrony: A new approach to better understand psychotherapeutic processes and drop-out. *J. Psychother. Integr.* **2018**, *28*, 367.
23. Mayo, O.; Gordon, I. In and out of synchrony—Behavioral and physiological dynamics of dyadic interpersonal coordination. *Psychophysiology* **2020**, *57*, e13574. [CrossRef]
24. Safran, J.D.; Muran, J.C. Resolving therapeutic alliance ruptures: Diversity and integration. *J. Clin. Psychol.* **2000**, *56*, 233–243. [CrossRef]
25. Villmann, T.; Liebers, C.; Bergmann, B.; Gumz, A.; Geyer, M. Investigation of psycho-physiological interactions between patient and therapist during a psychodynamic therapy and their relation to speech using in terms of entropy analysis using a neural network approach. *New Ideas Psychol.* **2008**, *26*, 309–325. [CrossRef]
26. Stukenbrock, A.; Deppermann, A.; Scheidt, C.E. The art of tentativity: Delivering interpretations in psychodynamic psychotherapy. *J. Pragmat.* **2021**, *176*, 76–96. [CrossRef]
27. Schiepek, G.; Schöller, H.; de Felice, G.; Steffensen, S.V.; Bloch, M.S.; Fartacek, C.; Aichhorn, W.; Viol, K. Convergent validation of methods for the identification of psychotherapeutic phase transitions in time series of empirical and model systems. *Front. Psychol.* **2020**, *11*, 1970. [CrossRef] [PubMed]
28. Helmich, M.A.; Olthof, M.; Oldehinkel, A.J.; Wichers, M.; Bringmann, L.F.; Smit, A.C. Early warning signals and critical transitions in psychopathology: Challenges and recommendations. *Curr. Opin. Psychol.* **2021**, *41*, 51–58. [CrossRef] [PubMed]
29. Dablander, F.; Pichler, A.; Cika, A.; Bacilieri, A. Anticipating critical transitions in psychological systems using early warning signals: Theoretical and practical considerations. *Psychol. Methods* **2023**, *28*, 765–790. [CrossRef]
30. Gumz, A.; Kästner, D.; Geyer, M.; Wutzler, U.; Villmann, T.; Brähler, E. Instability and discontinuous change in the experience of therapeutic interaction: An extended single-case study of psychodynamic therapy processes. *Psychother. Res.* **2010**, *20*, 398–412. [CrossRef] [PubMed]
31. de Felice, G.; Giuliani, A.; Pincus, D.; Scozzari, A.; Berardi, V.; Kratzer, L.; Aichhorn, W.; Schöller, H.; Viol, K.; Schiepek, G. Stability and flexibility in psychotherapy process predict outcome. *Acta Psychol.* **2022**, *227*, 103604. [CrossRef] [PubMed]
32. Schiepek, G.; Strunk, G. The identification of critical fluctuations and phase transitions in short term and coarse-grained time series—A method for the real-time monitoring of human change processes. *Biol. Cybern.* **2010**, *102*, 197–207. [CrossRef]
33. Viol, K.; Schöller, H.; Kaiser, A.; Fartacek, C.; Aichhorn, W.; Schiepek, G. Detecting pattern transitions in psychological time series–A validation study on the Pattern Transition Detection Algorithm (PTDA). *PLoS ONE* **2022**, *17*, e0265335. [CrossRef]

34. Olthof, M.; Hasselman, F.; Strunk, G.; Aas, B.; Schiepek, G.; Lichtwarck-Aschoff, A. Destabilization in self-ratings of the psychotherapeutic process is associated with better treatment outcome in patients with mood disorders. *Psychother. Res.* **2020**, *30*, 520–531. [CrossRef]
35. Scheffer, M.; Carpenter, S.R.; Lenton, T.M.; Bascompte, J.; Brock, W.; Dakos, V.; Van de Koppel, J.; Van de Leemput, I.A.; Levin, S.A.; Van Nes, E.H.; et al. Anticipating critical transitions. *Science* **2012**, *338*, 344–348. [CrossRef]
36. Mergenthaler, E. Resonating minds: A school-independent theoretical conception and its empirical application to psychotherapeutic processes. *Psychother. Res.* **2008**, *18*, 109–126. [CrossRef]
37. Caro Gabalda, I.; Stiles, W.B. Why setbacks are compatible with progress in assimilating problematic themes: Illustrations from the case of Alicia. *Psychother. Res.* **2021**, *31*, 386–401. [CrossRef]
38. Salvatore, S.; Gelo, O.C.G.; Gennaro, A.; Metrangolo, R.; Terrone, G.; Pace, V.; Venuleo, C.; Venezia, A.; Ciavolino, E. An automated method of content analysis for psychotherapy research: A further validation. *Psychother. Res.* **2017**, *27*, 38–50. [CrossRef] [PubMed]
39. Christensen, A.P.; Kenett, Y.N. Semantic network analysis (SemNA): A tutorial on preprocessing, estimating, and analyzing semantic networks. *Psychol. Methods* **2023**, *28*, 860–879. [CrossRef] [PubMed]
40. Christian, C.; Barzilai, E.; Nyman, J.; Negri, A. Assessing key linguistic dimensions of ruptures in the therapeutic alliance. *J. Psycholinguist. Res.* **2021**, *50*, 143–153. [CrossRef] [PubMed]
41. Zimatore, G.; Tsuchiya, M.; Hashimoto, M.; Kasperski, A.; Giuliani, A. Self-organization of whole-gene expression through coordinated chromatin structural transition. *Biophys. Rev.* **2021**, *2*, 031303. [CrossRef]
42. Keul, N.D.; Oruganty, K.; Schaper Bergman, E.T.; Beattie, N.R.; McDonald, W.E.; Kadirvelraj, R.; Gross, M.L.; Phillips, R.S.; Harvey, S.C.; Wood, Z.A. The entropic force generated by intrinsically disordered segments tunes protein function. *Nature* **2018**, *563*, 584–588. [CrossRef] [PubMed]
43. Po, A.; Giuliani, A.; Masiello, M.G.; Cucina, A.; Catizone, A.; Ricci, G.; Chiacchiarini, M.; Tafani, M.; Ferretti, E.; Bizzarri, M. Phenotypic transitions enacted by simulated microgravity do not alter coherence in gene transcription profile. *NPJ Microgravity* **2019**, *5*, 27. [CrossRef] [PubMed]
44. Hartkamp, N.; Schmitz, N. Structures of introject and therapist–patient interaction in a single case study of inpatient psychotherapy. *Psychother. Res.* **1999**, *9*, 199–215.
45. Hayes, A.M.; Laurenceau, J.P.; Feldman, G.; Strauss, J.L.; Cardaciotto, L. Change is not always linear: The study of nonlinear and discontinuous patterns of change in psychotherapy. *Clin. Psychol. Rev.* **2007**, *27*, 715–723. [CrossRef]
46. Salvatore, S.; Gelo, O.; Gennaro, A.; Manzo, S.; Al Radaideh, A. Looking at the psychotherapy process as an intersubjective dynamic of meaning-making: A case study with discourse flow analysis. *J. Constr. Psychol.* **2010**, *23*, 195–230. [CrossRef]
47. Gumz, A.; Bauer, K.; Brähler, E. Corresponding instability of patient and therapist process ratings in psychodynamic psychotherapies. *Psychother. Res.* **2012**, *22*, 26–39. [CrossRef]
48. Polman, A.; Bouman, T.K.; van Geert, P.L.; de Jong, P.J.; den Boer, J.A. Dysfunctional beliefs in the process of change of cognitive treatment in obsessive compulsive checkers. *Clin. Psychol. Psychother.* **2011**, *18*, 256–273. [CrossRef]
49. Gonçalves, M.M.; Mendes, I.; Cruz, G.; Ribeiro, A.P.; Sousa, I.; Angus, L.; Greenberg, L.S. Innovative moments and change in client-centered therapy. *Psychother. Res.* **2012**, *22*, 389–401. [CrossRef] [PubMed]
50. Gonçalves, M.M.; Ribeiro, A.P.; Stiles, W.B.; Conde, T.; Matos, M.; Martins, C.; Santos, A. The role of mutual in-feeding in maintaining problematic self-narratives: Exploring one path to therapeutic failure. *Psychother. Res.* **2011**, *21*, 27–40. [CrossRef] [PubMed]
51. Hayes, A.M.; Yasinski, C. Pattern destabilization and emotional processing in cognitive therapy for personality disorders. *Front. Psychol.* **2015**, *6*, 107. [CrossRef] [PubMed]
52. Schiepek, G.; Eckert, H.; Weihrauch, S. Critical Fluctuations and Clinical Change: Data-Based Assessment in Dynamic Systems. *Constr. Hum. Sci.* **2003**, *8*, 57–84.
53. Schiepek, G.K.; Tominschek, I.; Heinzel, S. Self-organization in psychotherapy: Testing the synergetic model of change processes. *Front. Psychol.* **2014**, *5*, 1089. [CrossRef] [PubMed]
54. Heinzel, S.; Tominschek, I.; Schiepek, G. Dynamic patterns in psychotherapy-discontinuous changes and critical instabilities during the treatment of obsessive-compulsive disorder. *Nonlinear Dyn. Psychol. Life Sci.* **2014**, *18*, 155–176.
55. Halfon, S.; Çavdar, A.; Orsucci, F.; Schiepek, G.K.; Andreassi, S.; Giuliani, A.; de Felice, G. The non-linear trajectory of change in play profiles of three children in psychodynamic play therapy. *Front. Psychol.* **2016**, *7*, 1494. [CrossRef]
56. Halfon, S.; Cavdar, A.; Paoloni, G.; Andreassi, S.; Giuliani, A.; Orsucci, F.; de Felice, G. Monitoring non-linear dynamics of change in psychodynamic play therapy. *Nonlinear Dyn. Psychol. Life Sci.* **2019**, *23*, 113–135.
57. Cornell, W.F.; Bucci, W. *Emotional Communication and Therapeutic Change: Understanding Psychotherapy through Multiple Code Theory*; Routledge: Oxford, UK, 2020.
58. Li, X.; Kivlighan, D.M., Jr. Examining therapy dynamics and session outcome using differential equations model and multilevel data disaggregation. *Psychother. Res.* **2020**, *30*, 604–621.
59. Paz, A.; Rafaeli, E.; Bar-Kalifa, E.; Gilboa-Schectman, E.; Gannot, S.; Laufer-Goldshtein, B.; Narayanan, S.; Keshet, J.; Atzil-Slonim, D. Intrapersonal and interpersonal vocal affect dynamics during psychotherapy. *J. Consult. Clin. Psychol.* **2021**, *89*, 227. [CrossRef]
60. Tschacher, W.; Haken, H. Causation and chance: Detection of deterministic and stochastic ingredients in psychotherapy processes. *Psychother. Res.* **2020**, *30*, 1075–1087. [CrossRef] [PubMed]

61. Schiepek, G.K.; Viol, K.; Aichhorn, W.; Hütt, M.T.; Sungler, K.; Pincus, D.; Schöller, H.J. Psychotherapy is chaotic—(not only) in a computational world. *Front. Psychol.* **2017**, *8*, 379. [CrossRef] [PubMed]
62. Schöller, H.; Viol, K.; Aichhorn, W.; Hütt, M.T.; Schiepek, G. Personality development in psychotherapy: A synergetic model of state-trait dynamics. *Cogn. Neurodynamics* **2018**, *12*, 441–459. [CrossRef]
63. Henzler-Wildman, K.; Kern, D. Dynamic personalities of proteins. *Nature* **2007**, *450*, 964–972. [CrossRef]
64. Malaney, P.; Pathak, R.R.; Xue, B.; Uversky, V.N.; Davé, V. Intrinsic disorder in PTEN and its interactome confers structural plasticity and functional versatility. *Sci. Rep.* **2013**, *3*, 2035. [CrossRef] [PubMed]