The Process of Psychotherapy – Causation and Chance

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chapter abstracts

1. Causation and Chance – Integrating the dynamical-systems approach with statistical thinking

Abstract:

We view psychotherapy from an explicitly process-based perspective. The general goal of the book is to model the process of psychotherapy as an interplay of chance and causation. This means that deterministic interventions as well as random fluctuations must be considered, both as functions of time. Such fluctuations can be influenced by means of stochastic interventions. Several mathematical models have been put forward for the modeling of such dynamics, from which we choose the Fokker-Planck approach. The fundamental prerequisite of dynamical modeling is that we can measure and monitor the processes of psychotherapy. We therefore discuss the problems of psychological measurement, especially how we may measure mental and experiential processes, which are first-person phenomena, i.e. not objective data. Psychology uses scales to get access to such data. We must rely on operationalizations as the fundament of psychological measurement, as is true in all empirical research in psychology. Psychotherapy is in principle based on the social interaction of therapist and client, their alliance, thus we will also have to model this two-dimensional system.

2. Psychopathological problems and disorders

Abstract:

Modeling psychotherapy implies that we also have to deal with the reasons why treatment is demanded. Commonly, the client enters psychotherapy because of a psychopathological condition in need of cure and remediation. There are two major classification systems of psychopathology, the "International Classification of Diseases" (ICD) and the "Diagnostic and Statistical Manual of Mental Disorders" (DSM). These systems and their shortcomings are briefly presented. Both rely largely on the definition of disorders as categories. The categorical definition of all disorders, however, leads to a number of conceptual problems, which are increasingly discussed in psychiatry. Such problems are the heterogeneity inside a diagnostic category, and artificial classificatory comorbidity, which both threaten the reliability and validity of diagnoses. This unfortunate state of the field has lead to the Research Domain Criteria (RDoC) initiative in an attempt to reach a solid evidence base for psychopathology research. RDoC however is biased towards biological units of analysis. For the sake of our modeling approach in psychotherapy, psychological and physiological state variables have priority, and dimensional scaling is preferable because it allows depicting courses of psychopathology by time series. Stable states of pathology are considered as attractors. Therefore, we conceive of psychopathology as a hierarchy of dimensional variables, with signs and symptoms at the bottom level, disorders at the intermediate level and spectra of psychopathology at the top level. The "Hierarchical Taxonomy of Psychopathology" (HiTOP) is an example of such a conception of psychopathology.

3. Interventions in psychotherapy

Abstract:

Analogous to the hierarchy of dimensional variables in psychopathology, we postulate that there is also a hierarchical system of psychotherapeutic interventions. Therapeutic techniques (specific factors of intervention) make up the bottom level of this hierarchy, at an upper level we place the common (unspecific) factors, and classes of common factors comprise the top level. This model of psychotherapy deviates from the supposed antagonism of *either* common factors *or* techniques as the most effective interventions. We argue instead that both types of interventions depend on each other in that the common factors are implemented by techniques, and both must therefore be positioned at different levels of a hierarchy. Both types are deterministic interventions, yet with a different profile of action. Common factors address the affordances (in terms of synergetics, the control parameters) of the therapy system, which can lead to new pattern formation by self-organizational dynamics. Common factors are thus contextual interventions, in reference to Wampold's contextual model of psychotherapy. In addition, we emphasize the importance of therapist effects. Recent research has shown that therapists' resilience and mindfulness are systematically linked with higher effectiveness of these therapists.

4. The Fokker-Planck equation

Abstract:

In this chapter we derive the one-dimensional Fokker-Planck equation, which defines the change of the probability of a state variable *x* in dependence of time, i.e. $\frac{dP(x;t)}{dt}$. Starting from the Gaussian normal distribution, we formulate the deterministic drift term of the equation, which can be illustrated by the potential function of a fixed-point attractor (causation). Deterministic dynamics entailed by an attractor compresses state space. The stochastic diffusion term of the Fokker-Planck equation (chance) can be expressed by the variance of the Gaussian. Stochastic inputs expand state space and ultimately destroy attractors. The Fokker-Planck equation combines both dynamics, and thus integrates causation with chance in a process model. Deterministic forces can be measured by the relaxation time of a system, i.e. the duration until the equilibrium state is realized again after some displacement of *x*. The location and drift of attractors can be estimated by the means of the values of the state variable.

5. Application to psychotherapy: Deterministic interventions

Abstract:

We describe qualitatively how the Fokker-Planck equation can be applied to modeling the dynamics of psychotherapy. In this chapter, we focus on the deterministic term of the equation exclusively, i.e. on how the gradient of the potential function (the slope of the attractor) can be modified and/or how an attractor can be shifted to a different location in state space. To illustrate deterministic interventions, we have to differentiate between the four main clusters of psychotherapy modalities – behavioral, psychodynamic, humanistic-experiential, and systemic psychotherapy. Based on their differing treatment philosophies, change processes are accomplished in diverse ways. In systemic and especially humanistic therapies, which follow constructivist and non-

directive assumptions, therapeutic changes will rather arise from contextual interventions, i.e. they are based on common factors. We elaborate on this type of deterministic intervention as consistent with general principles of self-organization, demonstrated by the example of the Bénard system. Behavior therapy rests on a different mechanism of change by using specific techniques, i.e. by the direct applications of psychological learning theory. This is also true, albeit in different shape, for psychoanalysis and psychodynamic therapy.

6. Application to psychotherapy: Chance interventions

Abstract:

This chapter is dedicated to the stochastic term of the Fokker-Planck equation in the modeling of dynamics in psychotherapy. We define stochastic interventions as ways to utilize sources of random fluctuations, either by augmenting or reducing stochastic inputs. We find that on top of the intrinsic stochasticity of state variables, a major source of such inputs stems from the environment of therapy systems, and can thus be modified by boundary regulations and filtering of noise. Boundary regulation can bear on the social environment of a client, e.g. by a warding-off of social stimuli by milieu therapy, hospitalization, retreats, or by reducing the permeability of family subsystem boundaries. Mental processes may also be subject to intrusions of stochastic emotional and cognitive inputs, and there are interventions that can up-regulate (e.g. free association) or down-regulate (e.g. mindfulness, relaxation) such inputs. We find that all stochastic interventions also have deterministic functions because in therapy they follow a beneficial goal. In an overview of all types of intervention, we illustrate how the traditional distinction of common factors versus specific techniques relates to the Fokker-Planck model with its deterministic, contextual, and stochastic interventions. We also summarize to which degree these interventions are expressed in the four different psychotherapy approaches.

7. Application to psychotherapy: The mixture of deterministic and stochastic interventions

Abstract:

The Fokker-Planck model of psychotherapy integrates stochastic with deterministic interventions. In a case example of a client with a severe depressive episode, we computer-simulate how the underlying attractor landscape (three point attractors located at different values of depression) can be changed by stochastic and deterministic simulated 'interventions'. We illustrate how random inputs are capable of destabilizing a psychopathological attractor. Contextual interventions, originating from common factors associated with emotional and motivational processes, may change the attractor landscape as a whole. They act like affordances. We suggest how a momentary deterministic 'push' of the system state can be modeled mathematically. We conclude with the suggestion that in naturalistic psychotherapy practice, one commonly sees a mixture or sequence of deterministic, stochastic and contextual interventions. There is probably no one ideal course of therapeutic action, and different therapy approaches may be similarly effective, so that several roads may 'lead to Rome'.

8. The One- and Two-dimensional Fokker-Planck Equation

Abstract:

The Fokker-Planck model of psychotherapy can be developed in on or two dimensions. We put forward minimal models for both cases. In the one-dimensional minimal model, we formalize how the therapist can influence client states. We use the slaving principle of synergetics, which claims that slow variables entrain (i.e. 'enslave') the behavior of the quick variables during pattern formation. Applied to therapist and client, this means that the therapist should be 'slow', i.e. have long relaxation times. This is consistent with findings of psychotherapy research suggesting that resilient, stable, and nonjudgmental therapists are actually more effective. In our model, therapist personality has an essential impact of client states. Preferably, the therapist should not be overly influenced by random events, and the coupling of the client to the therapist should be higher than vice versa. The two-dimensional minimal model allows modeling the therapist-client relationship by a limit cycle, i.e. a periodic attractor. This model dispenses with the slaving principle and allows for both oscillations and synchronized phase-shifted coupling of therapist and client behavior, thus linking the theoretical model with empirical findings on interactional synchrony. Synchrony research often applies cross-correlational methods, and we give a short summary of this research. The phase-shift of the minimal model can be related to the empirically found cross-correlations. We conclude the structural-mathematical modeling of the process of psychotherapy by a two-dimensional Fokker-Planck equation.

9. Modeling empirical time series

Abstract:

The relevant parameters of the one-dimensional Fokker-Planck equation can be estimated from empirical time series of the state variable x. The deterministic forces that derive from attractors in state space and the production of stochasticity are represented by the functions $K(x)$ and $Q(x)$, respectively, which express how force k and diffusion Q vary with different values of state x. In empirical data, the functions can be derived from the (deterministic) slopes at each x and the (stochastic) standard error of the slopes at each x. From $K(x)$ we compute the potential function $V(x)$ by integration, and we can thus depict the attractor landscape that is inherent in the time series. In two-dimensional time series, which may represent both the therapist's and client's behavior, we are interested in the coupling (synchrony) of their behavior streams. We therefore compute the synchrony of therapist and client using the application SUSY (surrogate synchrony), which is based on windowed cross-correlation controlled by surrogate tests. An alternative application to estimate synchrony is the concordance index, which focuses on the correlations of window-wise slopes of therapist-client time series. Finally, we also compute $V(x)$ of the cross-correlations to detect possible attractors. In this chapter, we conduct time series analyses of exemplary behavioral and physiological datasets sampled at high frequency (one-dimensional systems: body movement, respiration, electrocardiogram, simulated Markov process; two-dimensional systems: body movements, respiration, electrocardiograms of two persons in interaction). We find that the applications yield the deterministic and stochastic signatures of the empirical time series as well as the synchrony and entrainment of the two-dimensional data.

10. Outlook

Abstract:

In this outlook chapter we discuss what was accomplished by the Fokker-Planck modeling of psychotherapy processes, and suggest directions for future research. We emphasize that psychotherapy research should focus on the dynamics, preferably using time series with high resolution which deliver insight into the dynamics even within the range of few seconds, the 'nowness' of embodied consciousness. A further prominent issue is therapeutic coupling and entrainment using measures of synchrony, where there is need to further standardize the various computational approaches. We claim that therapeutic intervention may be achieved by the "Archimedean role" of the therapist, who obtains leverage through his or her personality. These are implications and conclusions based on the minimal models developed in previous chapters. When focusing on the affordances of the therapeutic setting, we arrive at a new interpretation of the contextual model: contextual-deterministic interventions utilize especially the motivational common factors, such as resource activation or cognitive dissonance, in order to modify the attractor landscape of a client.