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Self-Organization and Clinical Psychology

Empirical Approaches to Synergetics in Psychology

With 156 Figures

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Application of Synergetics to Clinical Psychology

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The present contribution shows that clinical psychology as a theoretical and applied science is essentially concerned with phenomena of autonomous order formation and transformation within complex, dynamic systems. Evidence for this is provided by examples derived from clinical assessment, epidemiology, etiology research, psychotherapy and the dynamics of multipersonal systems. It is described how the theoretical and methodological instruments provided by synergetics may be employed in analyzing, explaining and perhaps even modifying such processes of self-organization. The concepts utilized in synergetics are explained and the synergetic systems concept is distinguished from various other conceptualizations (such as interactional constellations of several individuals or the systems concept of autopoiesis).

1. Evolution of Order of Psychosocial Phenomena

1.1 Why Synergetics in Clinical Psychology ?

There is no doubt that synergetics has become one of the most encompassing theoretical conceptualizations in modern science since it was introduced more than two decades ago (e.g. Haken & Graham 1971). It is a scientific concept which keeps its promise of offering an integrating and general approach. The precise mathematical formulation of its theoretical assumptions (Haken 1983a, b; 1990a; see Haken 1988 for macroscopic synergetics) forms the core of this approach. A large number of areas of application (domains), beyond the original experimental paradigm, laser physics, were identified after these central formulations had been accordingly extended and specified, thus fulfilling the requirements of a structuralistic view of theorizing (e.g. Stegmüller 1973). Synergetics has been applied to scientific fields such as thermodynamics, fluid dynamics, phenomena of collective and dynamic order formation in chemistry, biochemistry, meteorology, biology (e.g. morphogenesis and population dynamics), neurobiology, cognitive science, sociology, and economics. Even the basic disciplines of psychology have already begun to model perception, cognition and psychological development, all of which exhibit characteristics of complexity and discontinuous dynamics (phase transitions), using synergetic conceptualizations (see Haken, this volume; contributions to Haken & Stadler 1990, e.g. Stadler & Kruse 1990; Kruse & Stadler 1990; Bischof 1990). As has been pointed out (Stadler &

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Kruse 1990), there are obvious parallels to German Gestalt psychology (see Köhler 1920; 1940; Wertheimer 1912; 1923; and others).

However, apart from certain exceptions (Kriz 1990), synergetic concepts have not been introduced into clinical psychology. In general, this discpline finds it hard to integrate systems theory and ideas of self-organization, as can be observed from the latest textbooks (Reinecker 1990a; Baumann & Perrez 1990). Nevertheless the fact that there is no lack of differing concepts, this must not necessarily be a disadvantage. On the contrary: First of all, the utilization of theories from other disciplines for heuristic purposes does not guarantee better quality, as one might have to "bend and distort" one's own field of interest to make it fit the theory in question. Secondly, synergetic terminology which uses terms such as "control parameters" or "slaving principle" poses the danger of inviting technical thinking to come in through the systemic back door (through which it had not been expected) and enter the psychosocial practice once again. This would be even more regrettable, as academic psychotherapy research has only just begun to abandon with great effort technologically oriented concepts of intervention with the help of the approaches of community psychology and heuristic concepts of therapy (Caspar & Grawe 1989). Thirdly, it is evident that it is not possible to apply a certain theory to every field of interest. There certainly are areas of research in clinical psychology which, at first glance, deal neither with phenomena of dynamics nor with order formation. These include classification, epidemiology, outcome evaluation and cost-effectiveness evaluations.

However, if one takes a closer look at clinical psychology, it soon becomes evident that much of the work in clinical research and practice is aimed at the development and change, as well as the identification and recognition of structures of order within complex, dynamic systems.

1.2 Classification and Clinical Assessment

The very first step, psychodiagnostic classification, the controversial assignment of human suffering and interpersonal problems to nosological entities, itself constitutes a process of identifying complex patterns, or, in other words, of pattern recognition. This is substantiated by findings indicating how quickly this process of diagnostic pattern-identification takes place (see Blaser 1977). Obviously only a few pieces of information may already suffice as the basis for a symmetry breaking in favor of a certain order parameter (in this case a certain discrete diagnostic category), and further information is utilized merely to confirm or differentiate the decision made. Principles governing Gestalt recognition and associative memory processes contribute to rendering fragmentary patterns complete and to producing the most concise pattern possible (potential valley). Haken's postulate that "the order parameters have features required by gestalt theory" (1990b, p. 11) might also apply to processes of clinical assessment, and thus present an alternative to regarding clinical assessment as guided by criteria of inclusion and exclusion as well as by decisions following the guidelines of flow charts (compare DSM III and

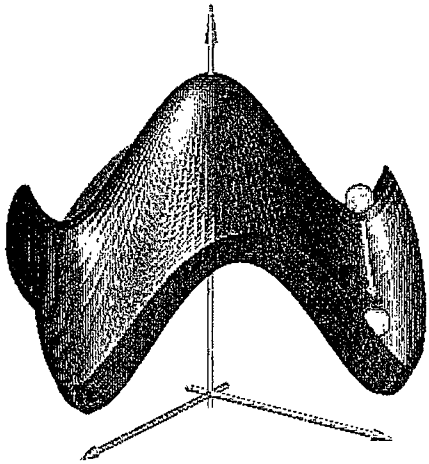

Fig. 1: Visualization of the potential landscape for two prototype patterns and two features (from Haken 1990b, p. 13).

DSM III-R, APA 1987): The process of clinical assessment being governed by principles inherent to the synergetic computer. In this view, diagnosticians' decisions are assumed to be based on standard examples or ideal types stored as prototype pattern v_u, rather than on lists of criteria. A test pattern $q(0)$ containing (possibly incomplete) initial information is transformed during the process of recognizing complex patterns, until it coincides with the most similar of the stored prototype patterns v_u

$$q(0) \longrightarrow q(t) \longrightarrow v_u. \tag{1}$$

When potential landscapes are utilized as a means of representation, the process described above is illustrated by that of a ball rolling into a potential valley (Fig. 1).
The basic equation representing this process of pattern recognition is given as

$$\dot{q} = \sum_u \lambda_u \bar{A} v_u (v_u^+ A q) + N(v_u^+ A q) + F(t), \tag{2}$$

where

- q is the state vector which encodes a specific feature
- λ_u represents u different attention parameters designating attention biases which may be caused by a specific sensitivity to certain phenomena, by emotions (such as avoidance or fear of proximity) or by certain diagnostic interests (e.g. due to a specific focus of research)
- A is an adaptation operator which influences q and leads to its matching with v_u^+
- v_u represents u different prototype patterns with the external product of vectors $v_u \cdot v_u^+$ serving as a learning matrix (v_u^+ is the vector adjoint to v_u)

N is a nonlinear function N $(\underset{\sim}{v}_u^+ A\underset{\sim}{q})$ which serves to differentiate between different patterns and their degree of saturation and

$\underset{\sim}{F}(t)$ represents internal and external fluctuations of the system.

Thus, this equation covers basic psychological aspects (such as the individual's learning history and hypothesis formation, his ability to differentiate, as well as motivational biases of perception), as also discussed in the empirical literature on cognitive science, perception psychology and clinical assessment.

The order parameters ξ_u of pattern recognition processes thus described can be defined by means of the scalar product

$$\xi_u(t) = (\underset{\sim}{v}_u^+ A\underset{\sim}{q}) \qquad (3)$$

with the order parameters representing specific patterns of behavior, perception and cognition on a macroscopic level.

The analogy between pattern formation and pattern recognition is the basis for the development of the synergetic pattern recognition computer: "...in pattern formation when a part of a system is in an ordered state, it can generate its corresponding order parameter which in turn forces the rest of the system into the totally ordered state. Similarly, in pattern recognition a set of known features can generate their corresponding order parameter which in turn forces the rest of the system into the total state that represents the total pattern in the sense of associative memory" (Haken 1990b, p. 11).

This approach may also be employed to explain clinical assessment processes taking place within a very short time on the basis of incomplete information (compare above; Blaser 1977). Also, it would be possible to generate further hypotheses, for example concerning phenomena such as multistability within certain stages of diagnosticians' clinical assessment.

A very well-known empirical finding concerns the α-error of the re-diagnosis of patients who have already been diagnosed previously. As shown by Rosenhan (1973), diagnostic labels are hardly ever abandoned, even though the required criteria are not or no longer observable. Thus, patients who had been diagnosed as "schizophrenic" were labeled "remitted schizophrenic" on being discharged from the clinic, although their diagnoses had not been justified at any time. This phenomenon may be understood in analogy to that of hysteresis as a desynchronisation of the phase transitions on the way from percept a to percept b as opposed to that from percept b to percept a (compare Schwegler 1978; Haken 1990b). This effect is illustrated in Fig. 2.

Looking at the row of pictures from left to right, one first sees a face, which is then deformed in an indefinite manner until one suddenly perceives the figure of a girl. However, if one begins to look at the pictures starting from the right-hand side, the percept of the figure of the girl persists far beyond that point where it had become a girl when looking at the pictures in the opposite direction. The field of synergetics enables a mathematical formulation of this delayed switching from order parameter ξ_1 to ξ_2 as opposed to that from ξ_2

to ξ_1 (see Haken 1990b, p. 22ff.), an effect which is in accordance with assumptions of the 'hypothesis theory' of perception (e.g. Bruner & Postman 1949; Lilli 1978).

1.3 Analytic Epidemiology

Another field of clinical psychology where questions are usually not approached from the perspective of self-organization is that concerned with epidemiology. According to the traditional approach, the prerequisites of descriptive epidemiological research are the ability to clearly define and classify the disorder in question, coupled with minute and painstaking field investigations, especially with regard to primary surveys. However, questions of pattern formation within complex systems comprising large numbers of individuals and possible sources of influence come into play as soon as the next step towards analytical and interpretative epidemiology is to be taken. At any rate, it is the task of analytic epidemiology to identify and explain the conditions for the occurrence of temporal and spatial clusters of certain mental disorders or their irregular distribution within a multidimensional space of possible causal factors. Apart from the covariation of the distribution of mental disorders with factors such as social stratum, family environment, residential area, biopsychological stress factors and age, there are also temporal changes in the frequency of occurrence, which often seem to develop in a discontinuous manner. Thus, Reinecker (1990b, p. 33) mentions drastic changes in the frequency of occurrence of several different disorders within only a few years or decades. Examples of this are the change in the rate of alcoholism after the Second World War, changes regarding the diagnosis of "hysteria" since the beginning of the century, the introduction of the diagnoses of "panic attacks" or "bulimia" into the DSM III (APA 1987), etc.

All in all, the occurrence of such patterns points to the conclusion that the factors involved are correlated rather than independent of each other. They exhibit cooperative behavior — thus violating the central limit value theorem of probability theory (see Haken 1983a, chap. 2) — suggesting synergetic explanations for these phenomena of pattern formation. It is feasible that synergetic modeling could give a far better account of the complexity of these phenomena than is possible by simply referring to general presumptions such as "social causation" or "social drift" (see Dohrenwend & Dohrenwend 1981).

1.4 Etiological Research

Another field within clinical psychology where researchers have tried to manage without self-organizational models is that concerned with etiology. Rather, it has been the aim to identify individual causal factors which lead to mental disorder becoming overt when affecting a vulnerable person. This kind of approach was then progressively called "multifactorial", "interactive" or "transmissive", while still implicitly starting out from the principle of strong causality, e.g. similar causal factors leading to similar effects. It is only on the basis of this principle that etiological research concerned with attributing a certain configuration of psychosocial problems to a certain configuration of causal factors makes any sense. However, questions concerning the problem of causality usually remain unsolved. As has already been demonstrated by the critics of classical methodology, neither the usual correlational study nor the cross-sectional study at two or more points in time provides an adequate answer to questions of causality. But even when the highly praised prospective longitudinal design is employed, it is not at all possible to include every relevant factor, which means that an arbitrary number of rival explanations will remain untested depending on which theoretical approach has been chosen. It should be the main focus of research, that is to say of theoretical conceptualization and empirical survey, to examine how the relevant causal factors interact in the course of time and lead to specific configurations of psychosocial problems or disorders under specific, varying initial conditions. However, when the complex dynamics are taken into account, this again modifies the specific meaning of the individual factors. Moreover, even those etiological models promising the consideration of processes in an integrating or interactive way do not go beyond simply enumerating subprocesses, postulating inadequately specified interactive processes or relating subprocesses in such a way (e.g. assuming positive feedback loops only) that it seems implausible from a systems-theoretical point of view. This argument however also applies to those recent models which are adequately elaborated regarding the individual factors (e.g. Lewinsohn et al. 1985, with regard to the etiology of depression; see Hautzinger & de Jong-Meyer 1990 for a survey).

Mental suffering or "disorder" has been conceived of in terms of highly structured coherent states which impair and determine an individual's mental and social being since as far back as the classical phenomenological approach to psychopathology; put differently, these states are seen as considerably reducing the individual's "degrees of freedom". Very often we can observe discontinuous transitions between different pathological states or between states of health and illness which resemble those nonlinear phase transitions observable within highly complex physical systems (compare Haken 1989). This has been demonstrated, for example, with regard to uni- or bipolar cyclic depression (e.g. Wehr & Goodwin 1979) and schizophrenia. Strauss (1989) emphasizes the discontinuity in the evolution of patient functioning over time and describes several temporal patterns found in schizophrenia (e.g. "woodshedding", "the low turning point", "oscillating levels of function"; see also Schiepek, Schoppek & Tretter, this volume). It therefore seems obvious to attempt the utilization of synergetic concepts with respect to etiological research and dynamic psychopathology (Schmid 1991). After all, synergetics presents an elaborate theory of disorder-to-order as well as order-to-order transitions within highly complex nonlinear systems. (With regard to clinical psychology, these are biopsychosocial systems.) Moreover, this view is supported by the fact that, as mentioned above, the principle of strong

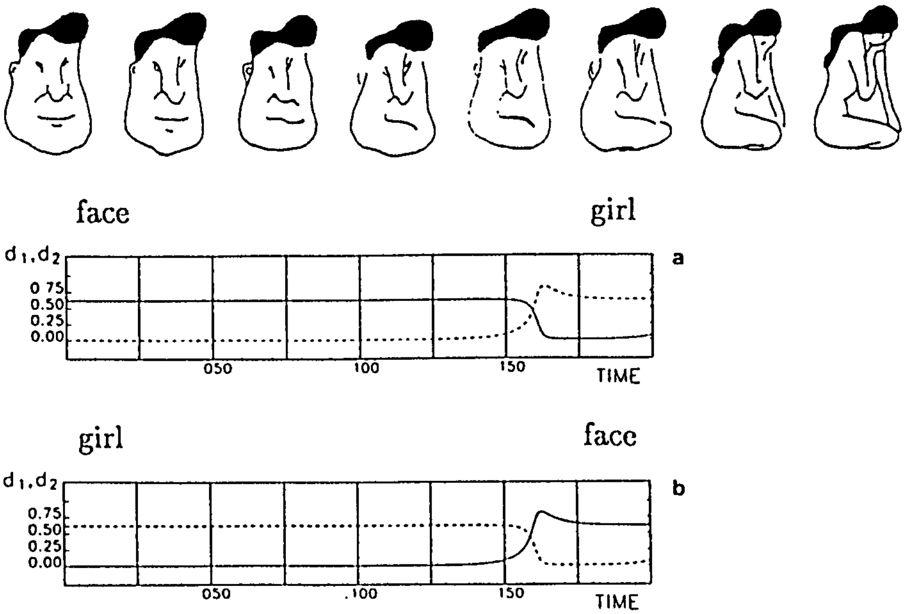

Fig. 2: Visualization of the hysteresis present in the perception of a man's face or a girl.
(a) Transition from the perception of a man's face to that of a girl.
(b) Transition from the perception of a girl to that of a man's face. Note the difference in the switching between figures (a) and (b). (from Haken 1990b, p. 23/24).

causality obviously does not apply with respect to etiological processes, something which is indicated, e.g. by the unspecific effects of factors such as traumatic childhood experiences or life events.

Different initial conditions and different degrees of stress may result in similar pathological states (see for example Akiskal & McKinney 1975, regarding the concept of the "final common pathway" of the evolution of depression), while only minimum fluctuations within an individual's intrapsychic or environmental conditions may also lead to quite different effects (see the concept of "critical instability", Schiepek & Schaub 1991; Schaub & Schiepek, this volume).

Thus, two characteristic features of strange attractors (see Tschacher 1990) are combined with regard to etiological processes: the postulate of convergence (attraction) and the postulate of divergence (expansion), resulting in the crucial dependence of the evolution of such processes upon their initial conditions (Fig. 3).

Considering these premises, one may argue that the unspecific effects of life events (see various contributions to Katschnig 1980, especially Brown, Harris & Peto 1980) are no artefact of inadequate research methods but are rather a substantial feature of the nonlinear dynamics of etiological processes.

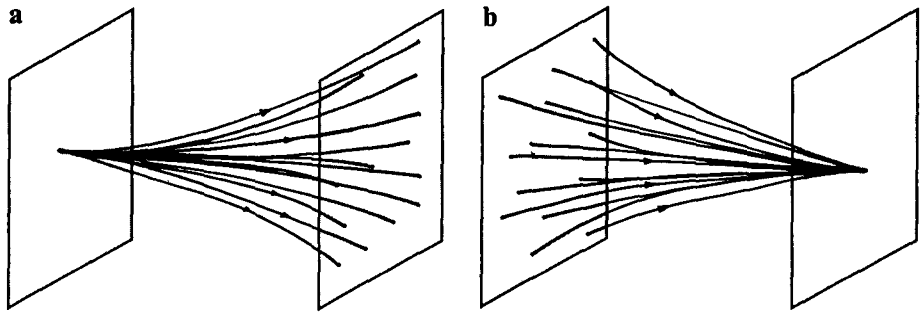

Fig. 3: Beyond the principle of strong causality: Convergence (a) and divergence (b) in the realm of "chaotic" causality.

1.5 Psychotherapy

The application of the concept of nonlinear phase transitions seems especially appropriate with regard to processes taking place within psychotherapy. They may be considered to represent nonlinear phase transitions between different biopsychosocial states of order. This view is supported by both practical experience and detailed analysis, indicating that therapeutic change obviously does not take place in the form of a continuous, incremental process, as may be suggested for example by the model of Skinner's shaping. On the contrary, we can observe the occurrence of sudden inspiration, "aha-experience" or the restructuring of problems — phenomena similar to the oscillating perception of ambiguous patterns — both during problem-solving and within psychotherapeutic processes (Stadler & Kruse 1990; Kruse & Stadler 1990; Mahoney 1980). Therapists are acquainted with the phenomenon of casual remarks or ideas being picked up by clients only after a substantial delay, and it often seem to be these fluctuations which then trigger the jump into a modified pattern of experience and behavior. This may be considered an effect similar to that described by Zeigarnik, who postulates a period of latency or distraction to be necessary after several trials of learning in order that the individual be enabled to spontaneously achieve a higher level of functioning than before with regard to the pattern of behavior to be acquired. It is the occurrence of phenomena such as those described above which supports the postulate of nonlinear processes being effective within psychotherapy. The transfer of methods applied in chaos research to the analysis of psychotherapeutic processes is therefore quite obvious (Fuhriman & Burlingame 1991; Burlingame et al. 1991). However, this requires a sufficient amount and range of quantitative, time-serial data, collected by employing an instrument which will provide measurement of adequately high resolution. Our research group at the University of Bamberg is currently preparing such time series by subdividing the therapy transcripts and video recordings of two completed therapies (twelve sessions each) into ten-second units and coding the interactional plans (see Caspar 1989) of both client and therapist. The time-series analysis of these data will allow us to ascertain their correlational dimension, and thus obtain empirical evidence for the chaotic dynamics effective within therapeutic processes.

The process of acquiring complex patterns of behavior was conceptualized as a process of "pattern formation" or, put differently, as a phase transition between different patterns of behavior by Kelso (1990), thereby presenting a synergetic learning theory. Apart from taking into account the intrinsic dynamics of learning, he especially succeeds in allowing for the consideration of intentional behavior, which, after all, represents an important aspect of human learning. Learning processes are considered as intentional, if information about the behavioral pattern to be learned is able to modify the intrinsic dynamics of the previous pattern, thus enabling a phase transition to take place (compare the purpose of goal identification and anticipation within psychotherapy). This implies that intentions act in the same space of collective variables as that in which the intrisic patterns are measured. "Intentional information defines an attractor in that space and is meaningful to the extent that it attracts the system toward an intended behavioral pattern. At the same time, intentions are restricted by the intrinsic dynamics, in that the ability to perform a particular pattern is influenced by the relative stability of the available patterns. In short, intentions parameterize the dynamics but are in turn constrained by the dynamics" (Kelso 1990, p. 261).

Kelso (1990) and co-workers have carried out numerous studies aimed at investigating the phase transitions between different rhythmic movements (e.g. parallel as opposed to antiphase finger movement). He concludes that in the case of intended behavior not corresponding to the intrinsic dynamics of the system — which is the usual case as far as learning processes are concerned — the question of which attractor will determine overt behavior depends on the intensity of the behavioral information given. "1. If behavioral information is weak or absent, the system's behavior is determined primarily by the intrinsic dynamics; 2. If behavioral information specifying a required behavioral pattern is strong, the system will possess a stable state at that required pattern" (Kelso 1990, p. 262).

Yet it is questionable with regard to therapeutic processes whether goal-oriented behavioral information alone is sufficient to effect a phase transition of the behavior of a biopsychosocial system into a desired state of attraction. Rather, one has to expect bistable or even multistable system behavior once the system begins to develop one or more attractors (or potential valleys) in addition to the attractor determining behavior so far (cf. Schiepek, Fricke & Kaimer, this volume, Fig. 1). We may also recognize such multistabilities during practical therapeutic work. Clients sometimes seem to process their experiences within quite different mental and emotional states, or "states of mind" (see Horowitz 1987). They may also repress or dissociate insights they have already gained, or reverse behavioral changes and pick them up again at a later date to work on them at an even more profound level. Planned, goal-oriented development is therefore rather unlikely during periods of psychosocial instability, because new attractors which determine behavior have not yet evolved; also, behavioral information determining emotional and social processes is still being worked out during a process of co-evolution on the basis of the intrinsic emotional dynamics of the client. It may be assumed that these processes are very sensitive to external fluctuations and take place at an unconscious rather than a conscious level (see Kruse & Stadler 1990; Revenstorf 1985, 1990).

At any rate, the synergetic concept of phase transitions between biopsychosocial states of order encourages researchers to take a closer look at characteristic features and processes of stability and instability within psychotherapy. The identification and empirical description of patterns or states of order within biopsychosocial systems is a fundamental prerequisite of this kind of research. We are currently undertaking efforts to this end by employing the concept of "lifestyle scenario" and measures proposed for its analysis (see Schiepek, Fricke & Kaimer, this volume).

Another systematic approach to pattern recognition in this difficult area of observation, termed "configurational analysis", has been developed by Horowitz (1987). "The approach is to segmentalize behavior and experience into states that recur; each "state of mind" is then explained in terms of the schemata that organize it, and the transition of states is described in terms of how representations and expressions of meaning are regulated. The stability of a given state will be explained essentially by a person's self-concept and inner model of relationship to others. The transitions from one state to another will be examined primarily in terms of events, including internal emotions and motives and the processing or avoidance of information related to these events, emotions and motives" (Horowitz 1987, p. 1). It can be expected that the concept of "states of mind", together with the corresponding configurational analysis and the synergetic concept of order-to-order transitions, will have a stimulating impact on therapy research.

1.6 Multipersonal Systems

In the field concerned with the dynamics of multipersonal systems (e.g. couples, families, groups, institutions) — in contrast to those areas of research in clinical psychology mentioned so far — phenomena of spontaneous order formation have always been regarded as presenting plausible explanations. It is a common experience that a group to which people are arbitrarily assigned develops a characteristic life of its own after only a short period of time. On Saturdays one may observe phenomena of coherence, together with a distinct reduction of degrees of freedom, among the spectators of soccer games. This example also shows that spontaneous, collective order formation (self-organization) usually prevails against (attempts at) organization by others (e.g. security guards) — something which becomes only too evident when one takes into consideration the catastrophic events in soccer stadiums in the past few years.

If we are concerned with a group consisting of a moderate number of people who did not know each other before, we can observe spontaneous processes of structure formation and identity development. The group will evolve to offer specific role positions and relations as well as its own we-feeling. We all know from experience that amazing things happen within such "systems": Dynamic processes and overall qualities may evolve which cannot simply be explained by regarding them as the sum of individual behavior or individual affective-cognitive schemata (Tschacher, Brunner & Schiepek, this volume). The term designating this process of *bifurcating* into the regime of newly developed attractors is that of "emergence" or, put differently, *emergent order formation*.

However, processes of emergent order formation also occur when people are not associated as a group, but rather widely dispersed (locally distributed), as within a society. An example of this is the evolution of public opinion (see Weidlich & Haag 1983). The changing of collective "modes" of behavior and attitudes regarding health care is of special importance for health psychology as well as clinical psychology, as these disciplines are concerned with information about, and the prevention of, mental and somatic disorder.

Processes occurring at the level of social systems are not necessarily more complicated than those occurring at the level of individual mental systems — it is merely a question of different levels of resolution. It is a well-known phenomenon in synergetics that the self-organizing, spontaneous activities of a system (pattern formation) occur along with a substantial reduction of degrees of freedom regarding the behavior of its elements, or, as Willke (1983) puts it: "The whole is *less* than the sum of its parts". A vivid example of this may be seen in the restrictions imposed on the possible behavior of family members and their relations towards each other by rigid family structures (compare Minuchin 1974). Apart from stable patterns, however, we may also expect chaotic dynamic processes to occur within social systems. As shown by Kratky (this volume), chaotic dynamics may exhibit rather different numbers of degrees of freedom, and it is possible to distinguish between low-dimensional and high-dimensional chaos. At any rate, chaotic dynamics represent a specific kind of order, one which can be distinguished from disorder or white noise by means of the identified dimensionality. The properties of information reduction (convergence, attraction) and information production (divergence) characteristic of strange attractors was already mentioned in Sect. 1.4. At the present time, however, empirical evidence is too sparse to answer the question as to whether — apart from physical, chemical, biological and cognitive systems (regarding the latter, see Nicolis 1986; Freeman 1990) — chaos also plays a part in the evolution of psychosocial systems, not only in a metaphorical but also in a mathematical sense (for an analysis of the correlational dimension of a group-therapy process, see Burlingame et al. 1991).

However, phenomenological evidence is available: The development of interpersonal relationships is often dependent upon *crucial initial conditions*, e.g. subtle nuances conveyed within the first impression, tiny gestures, minute bits of preliminary information. This *butterfly effect of social life* may be especially noticeable at the beginning of a love affair. Every smile and eye contact, every sign and its possible meaning may have farreaching consequences, may initiate a development, may invite or reject — a field of great insecurity (compare the figure of "Que faire" in Roland Barthes' "Fragment d'un discours amoureux" 1977). Over and above the special case of a beginning romance, every interpersonal encounter is characterized by double contingency (Luhmann 1984). This is a highly sensitive and instable state of symmetry, in which even minute fluctuations may suffice to break the symmetry of communication in favor of specific paths of communication, in which the partner may join again (see Markowitz 1991 with regard to the problem of double contingency).

Another indication of the chaotic features of social life can be concluded from the phenomenon of the *self-similarity* of social patterns. We often recognize similar patterns of interaction at different levels of communication (communication, meta-communication, meta-meta-communication etc.). An example: During a group-therapy session, the participants work on a problematic situation described by one of the members. The situation is illustrated by means of a group sculpture. The client explains how as a boy he was always driven to the wall for tiny reasons, how he had to appease his dominant accusers as a guilty child. While taking part in the sculpture he again makes excuses addressed towards his parents and significant others. When the sculpturing is finished, the actors are asked to report their observations, thoughts and feelings in order to be able to leave their roles. While doing so, a pattern of interaction develops which is similar to that represented in the sculpture. The main actor makes excuses — this or that wasn't that way, he only wanted to ..., he was sorry that, but ..., etc. It seems as if the accounts of the other members of the group have an invasive effect upon the client. The therapist then tells the group about his observations concerning the group processes here-and-now. But even after his intervention the process is repeated in an analogous way. Implicitly, the client makes excuses for constantly making excuses, and the rest of the group tries to explain his behavior in a reproachful way. Further attempts at clarification fail in the same way and the group dynamics become more and more entangled until finally all the participants feel guilty, angry and exhausted.

This is to show that meta-communication is not to be considered a universal remedy or cure-all; often it leads to nothing but the exact pattern from which it originally started.

We may recognize phenomena of scale-invariant self-similarity not only when analyzing the recursive loops of communication systems, but also when taking a closer look at the lifestyle of an individual across different time-scales. The specific patterns of an individual's lifestyle can be found on a large as well as a small scale. On a large scale, this may be represented as the way in which one makes difficult decisions or the avoidance of decision-making, the way in which a person arranges his or her relationships, or the way in which one meets others in passing or in which a person uses his or her time (Ciompi, personal communication; compare the concept of the lifestyle scenario, Schiepek, Fricke & Kaimer, this volume).

1.7 Conclusions

Each of the previous examples shows that the nonlinear processes and phenomena of self-organization occur everywhere within the traditional areas of the research and practice of clinical psychology. Clinical psychology can therefore be regarded as a theoretical and applied science, the genuine task of which is to analyze, and act within, complex dynamic systems, be they of biological, psychological or social nature. Normally, biological, social and psychological processes will be intricately interwoven, so that clinical psychology deals with biopsychosocial systems.

In order to gain an understanding of the dynamics of evolution of such systems, theories of nonlinear systems and especially synergetic conceptualizations will be necessary in the future. It is these theories which provide universally applicable scenarios for the explanation of the evolution of systems from disorder to self-organized order and from self-organized equilibrium conditions, via periods of instability, to new and more complex states of order. Generally speaking, this happens when certain parameters are changed which regulate the distance of the system from the point of thermodynamic equilibrium, and thus the extent of nonlinearity.

These transitions are characterized by bifurcations. Once the system has approached this point, minute fluctations may "throw the switch", leading to one specific state of equilibrium or another. At points of bifurcation the attractors governing the system behavior are "flat" (compare the effects of critical slowing down), so that it is random fluctations which effect the decisive symmetry breaking. Thus, the history of a nonlinear system is governed by an interplay of chance and necessity or, as proposed by evolution theory, variation and selection.

It should be clear by now that the synergetic approach to phenomena treated by clinical psychology neither leads to physicalist reductionism nor means mere metaphorical thinking. On the contrary, it presents a consistently *empirical* approach which sets constructive scientific endeavor against the renunciation of empirical analysis to which systemic approaches were dedicated because of their misinterpretation of constructivism (compare various contributions to this volume). Psychological synergetics can be regarded as an approach which allows the construction of adequate, sufficiently complex and scientifically fruitful models for the phenomena with which clinical psychology is concerned, models which, moreover, can be integrated into a coherent, interdisciplinary theoretical framework.

2. Synergetic Modeling of Complexity and Dynamic Processes Within Clinical Psychology

As described earlier, it is a central concern of clinical psychology to explain processes of order formation and transformation within complex dynamic systems, and also to promote such processes in specific ways, as in the case of psychotherapy.

We are thus faced with the question as to what can be determined to be a "system" or, in other words, what is an adequate, empirical conceptualization of a system, enabling us to apply this construct in an adequate way to empirical analysis. The following first describes different conceptualizations of this construct, in order to allow a distinction to be made from the conceptualization proposed here.

2.1 What is Regarded as a "System"?

There are various different normative definitions in clinical psychology as to what is regarded as a system. How this concept is defined is determined by specific conditions with respect to the person using this concept, such as his/her theoretical background, which discipline he/she is committed to, or the intended area of application. In principle, the conceptualization of the target of research as a system, together with the decision as to where the boundaries of the system are considered to be, depends upon the researcher's own disposition, although this freedom may be restricted by common institutional, methodological or theoretical agreements. It is the usual practice to declare as environment that part of the target of research considered to be outside the delimitations of the system, and to relate variations within the environment to system behavior. Incidentally, this corresponds to traditional experimental procedure.

The different varieties of the concept of "system" each supply a formal framework which must then be filled with actual content. The concept alone does not explain anything. It seems necessary here to point out that a semantic connotation has been attached to the term "system" (in the literature on family therapy or systemic therapy, for example) suggesting that the mere utilization of this term to designate families or other multipersonal constellations would present an explanation.

2.1.1 Systems as Interactional Constellations of Several Individuals

It has become especially popular within the family therapy approach to define a family or a group of persons as a system. The individuals (e.g. family members) are considered the elements, and the relationships or communicative interactions between individuals or subgroups (e.g. parent subsystem, sibling subsystem) the relations of the system. The system dynamics are considered the result of interpersonal communication and are interpreted in terms of dynamic relationship processes.

This conceptualization is supported by its face validity and simple descriptiveness, which are both given for assessable face-to-face interaction within families or small groups only. Modeling approaches such as structural diagrams (Minuchin) or family genograms or sculptures (Satir) are adequate for systems of this size. As soon as one is concerned with organizations, however, one is forced for reasons of practicability to abstract from individuals — there are too many. (Organigrams show functional units instead of individuals.) Yet it is an advantage of this individual-centered conceptualization that phenomena of communicative emergence are considered without losing sight of the individual person/personality and his/her psychological characteristics. This is of special importance for clinical and especially therapeutic application. If phenomena of transpersonal or interpersonal emergence were acknowledged, this sociopsychological systems concept could be linked with psychological data or theories. Thus, an unstable state of floating between two different risks would result: Either the main responsibility for complexity would be attributed to the elements of the system, that is to say to the individual person and his/her intrapsychic characteristics, thereby making the systems concept seem artificial, or, on the other hand, individual characteristics would be treated only as an epiphenomenon of characteristics of communication.

As could be expected, this instability exists only in theory. In reality, however, the symmetry is broken in favor of one of the two possibilities. Within family or systemic therapy, intrapsychic and biological processes were neglected while interpersonal processes were emphasized (see Minuchin or early publications by Selvini-Palazzoli and her team, for example), at least for as long as family therapy approaches were still developing their identity, thus rendering systems theory a rather naive communications theory. However, the examples mentioned in Sects. 1.2-6 should make it clear that a reduction of systems theory to an interpersonal communications theory cannot be the aim of clinical psychology. It is an absolute necessity that intrapsychic and biological processes be taken into consideration when one is concerned with biopsychosocial systems.

Another problem inherent to the systems concept described above has been pointed out by Kriz (1985). The relations of a system thus defined, i.e. communication, not only relate individuals, but are also concerned with how these individuals themselves relate to each other and, in turn, how individuals relate to this relationship, etc. It is easy to see that the problem of iterated recursive relations can be solved much better by applying Luhmann's (1984) systems-theoretical approach, which refrains from the naive assumption that communication refers to individual persons.

2.1.2 The Systems Concept of Autopoiesis

A recent and highly elaborated systems concept has been developed on the basis of the concept of autopoiesis and introduced to biological (an der Heiden, Roth & Schwegler 1985), psychological (Schiepek 1990; 1991, chap.

IV) and social (Luhmann 1984; Teubner 1990; Willke 1989) theories of self-organization. According to this conceptualization, a system is conceived of as an entity which produces and reproduces its components, its structures and its autonomous boundary by means of the self-referential operation of its components (detailed descriptions of this approach are given in the literature quoted). Within the framework of a general theory of self-referential systems (TSS), this systems concept allows an explanation of psychological and social processes (of structure formation and transformation, for example), and therefore its application within clinical psychology should be emphasized. In addition to the synergetic approach, the theory of self-referential systems offers the second main systems-theoretical approach to clinical psychology and is aimed at a consistent and coherent, but primarily qualitative, theorizing. However, this means that, in contrast to synergetics, which originates from formal mathematical modeling, operationalization and empirical analysis are much more difficult. By defining the basic components of a system (e.g. biomolecules, affective-cognitive units, communication) a distinction is made between qualitatively different (biological, psychological, social) types of systems. Following this distinction, the interaction of the components is analyzed. Synergetics, on the other hand, proceeds from the assumption of interactions taking place at a high degree of resolution between biological, psychological and social processes on a microscopic level to create a coherent pattern on a macroscopic level characterized by biological, psychological and social phenomena. Moreover, the synergetic approach primarily treats processes of order transformation (i.e. disorder-to-order and order-to-order transitions), while the theory of self-referential systems is primarily concerned with questions of how the organization and boundaries of a system are maintained (see Maturana 1982). This can be understood in the light of the fact that its origin in biology resulted in the investigation of internal processes maintaining the existence of autopoietic systems becoming the main focus of attention. It has been only in the second place and, more importantly, outside the domain of biology that questions of self-organization (disorder-to-order transitions) have been raised (see Teubner 1990). However, it has been possible to further elaborate the theory of self-referential systems with regard to psychological and social systems and make it a fruitful theory of self-organization. As far as biological systems are concerned, it is the hypercycle theory proposed by Manfred Eigen which presents a genuine theory of self-organization or, put differently, a theory of the evolution of life.

Despite their similarities, we plead for a strict distinction between the theory of self-referential systems, on the one hand, and synergetics, on the other, in order to avoid confusion with respect to terminology and content. Keeping these theories apart also means that they can enter into fruitful scientific competition with respect to rival explanations of the phenomena of self-organization.

2.1.3 The Systems Concept of Synergetics

The systems concept of synergetics cannot be described by means of a few single key words, as it comprises a whole model of the self-organization of complex systems (see below, Fig. 4). In the first place, synergetics assumes that a self-organizing system is constituted on a microscopic level by a large number of components, the behavior of which is characterized by a large number of degrees of freedom. To give an example, the molecules of a gas can be regarded as solid bodies moving about in an ideal Newtonian world and colliding every now and then in an elastic way. It is possible to draw up equations with respect to physical, chemical and biological systems describing such microscopic dynamics on the basis of substantiated assumptions about the laws governing the behavior and interactions of the microscopic components of the system in question. This allows a modeling of the microscopic dynamics, i.e. the behavior and interaction of a large number of components. Knowledge about the order parameters active on the macroscopic level thus results from knowledge about the laws effective on the microscopic level (Haken 1983a).

For various reasons, such a microscopic modeling has not been possible up to now, and might even be quite impossible in principle, in those biopsychosocial systems in which we are interested within the scope of psychological and psychiatric research. Neither field nor laboratory research enables an understanding that is in any way complete of the high degree of complexity of the components and processes which interact in multifarious ways, are linked up or act in parallel on the biopsychosocial microscopic level. (Examples of laboratory research concerned with processes on the microscopic level are the evoked-potentials research within neurophysiology (e.g. Birbaumer & Schmid 1990) and the approach of Ekman & Friesen (1978) aimed at analyzing microscopic movements of emotion expression.)

Here it is necessary to insert a word of caution about the risk of being misunderstood: We do not intend to support a simple, reductionist view by reducing psychological phenomena to the microscopic material components of a physical or chemical nature, such as atoms or molecules. Rather, *the microscopic level of psychological synergetics is conceived of as the virtual horizon of the maximum degree of resolution attainable in the course of the analysis of interacting biological, psychological and social processes*. This also means that psychological synergetics is an interdisciplinary approach, even at the microscopic level of analysis. This microscopic level is regarded as the hypothetical limit of the maximum degree of resolution. Thus the postulate of this biopsychosocial microscopic level can best be characterized as a basic axiom (see Tschacher 1990).

In psychology, therefore, we shall prefer to rely on a different approach of modeling designated by Haken (1988) as the "second foundation of synergetics". This approach is based upon the phenomenological identification of patterns generated by a system through self-organization. This pattern, representing the dynamics of the macroscopic variables of the system in question, presents the empirically accessible grounds for analysis. These empirically obtained data are to be explained, i.e. they form the explanandum. We have only conceptual assumptions at our disposal about the explanans, which must be reconstructed by means of a macroscopic model comprising the identification of the relevant *order parameters* (or macroscopic variables) of the pattern, their interactions and autorecursive relations, as well as the influence of specific control parameters.

Thus we postulate the existence of a macroscopic level defined by the order parameters or macroscopic variables of the system dynamics. We are concerned with a phenomenological level of observation and a description of variables commonly analyzed in psychological, psychophysiological and psychiatric research (including the corresponding constructs). Which variables are focused upon depends on the specific system in question. In synergetic terms, the order parameters on the macroscopic level represent the collective modes of behavior of a large number of individual processes and components. Just like the microscopic processes, the order parameters can be of biological, psychological or social nature, thus confirming practical experience regarding psychological and psychiatric phenomena which are often located at a right angle with respect to the boundaries of established disciplines. A detailed example illustrating these ideas is given by Schiepek, Schoppek and Tretter (this volume). In the analysis of schizophrenic processes presented there, control parameters (such as the metabolism of neurotransmitters) and order parameters (such as stress or expressed emotions) stand for biological, cognitive, affective, and interpersonal processes.

The existence of a specific relation between the macroscopic and the microscopic level renders the former the preferred level for methodological and theoretical analysis. Under certain conditions determined by the control parameters of the system the behavior of the microscopic components becomes coherent and organized. If such coherent behavior occurs without being explicitly imposed by the system's environment, this is termed *self-organization*. The process of self-organization distinctly reduces the degrees of freedom of the behavior of the microscopic components. This phenomenon enables us to describe the system's behavior completely by identifying the collective variables responsible for the coherent system dynamics, instead of having to draw up a list of the behavior of the system's components, which would in fact be infinite. The resulting emergent states of order (or, put differently, the collective modes of the hypercomplex behavior of the microscopic level) in turn "enslave" by these very modes or order parameters the behavior of the microscopic components. This observable coherent system behavior, resulting from processes of self-organization, will be termed *"pattern"* here. Let us add that one basic precondition for self-organization to occur is the openness of a system to an exchange of energy (and, in some cases, matter) with its environment. In the case of psychological self-organization this also includes sensory and social stimulation by the environment. If coherence and order reach a very high degree at the observable macroscopic level, then the phenomenon of self-organization possesses a high degree of face validity. It was the occurrence of simple equilibrium conditions within multicomponent systems which stimulated research into self-organization which all began with the research paradigms of the laser, the Bénard instability and the Belousov-Zhabotinsky reaction. Standing behavior patterns are observable once a certain mode of behavior prevails, thus drastically reducing the complexity of the system behavior. Dynamic behavior at the macroscopic level, on the other hand, may seem unpredictable or in disorder, i.e. chaotic and turbulent: If the system is far from thermodynamic equilibrium and there is a high degree of matter or energy throughput while certain control parameters exhibit high values, then the emergent order parameters (variables) alternate in chaotic ways. Thus chaos, especially low-dimensional chaos, may indicate the existence of a self-organizing system. Just as is possible with regard to the dynamics of a stable periodic or complex periodic system, the macroscopic dynamics of a system showing this type of chaos can be modeled by means of a nonlinear system of variables.

To summarize, it can be stated that the order parameters evolving out of a complex microscopic level through self-organization and their interaction can be considered as a system of variables and modeled accordingly. Thus, systems are defined as systems of variables by the macroscopic approach of psychological synergetics, precisely as suggested by Schiepek (1986; 1991) with respect to the method of idiographic systems modeling. Neither method takes as a starting point any ontological determination of biopsychosocial systems — neither for the microscopic nor for the macroscopic level. Rather, it is a vital characteristic of (psychological) synergetics that it starts out from an interdisciplinary and "structuralist" point of view, postulating that similar structures and dynamics will evolve out of very different substrata under certain given conditions. Fig. 4 shows a graphic summary of the ideas presented in this section, Fig. 5 gives an example (comp. also Fig. 8.).

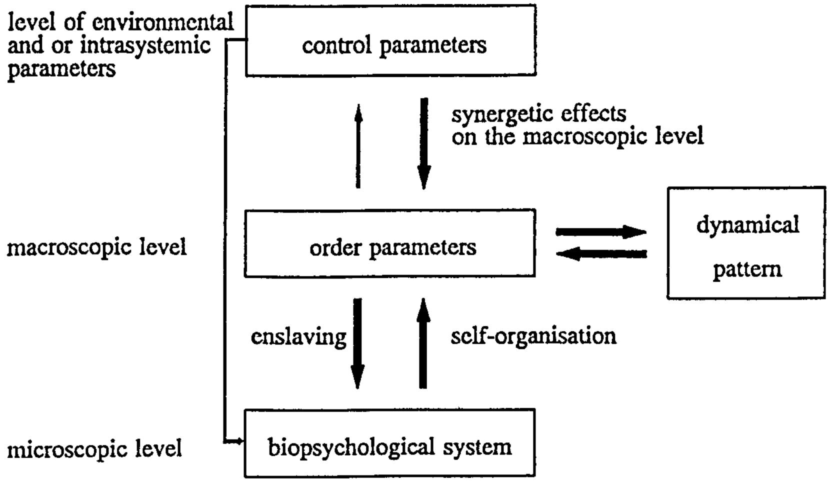

Fig. 4: The synergetic model of self-organization.

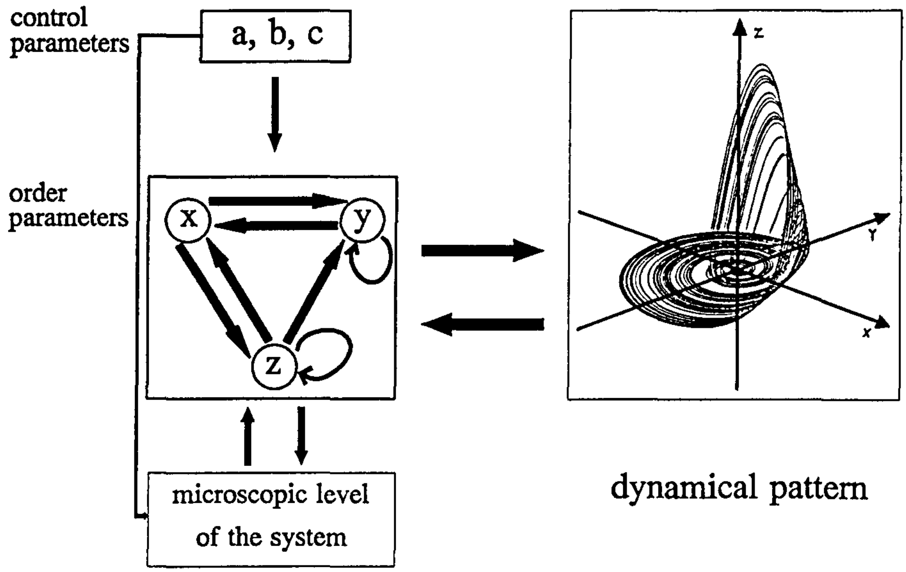

Fig. 5: An example of the interactions between macroscopic variables and the pattern of the pertaining system dynamics (here: Rössler attractor, phase space diagram).

2.2 The Problem of Determining Patterns, Variables, and the Macroscopic Model

It is usually assumed that the components constituting a system, the laws governing the components' behavior, and particularly the boundaries of the system are known when physical systems are analyzed. When the Bénard instability is investigated, for example, a fluid is poured into a flat tray of a round or rectangular shape which is then heated from below. Thus, both system and relevant environment are well-defined. Even the process of pattern recognition by the synergetic computer starts out from a clearly defined, digitalized reference pattern with given boundaries. However, the processes of pattern identification and explanation with which clinical psychology and psychiatry are confronted represent a very different situation.These fields of application offer neither fixed anchor points nor well-defined limits as to the target of investigation. The phenomena we are dealing with here can be considered "fuzzy sets". Regarding schizophrenia research, for example, what is to be determined as the relevant "pattern"? Is it the pathological features of a patient described in a qualitative fashion? The temporal evolution of the disorder? The peculiarities of interpersonal communication within the patient's family? The dynamics of the interpersonal relations within and between the psychosocial institutions taking care of the patient? The pattern of the patient's EEG? The dynamic patterns of specific biochemical values? Or something else? Which of the patterns is chosen surely depends on the researcher's interests and theoretical background, as well as the extent to which his/her method of approach allows, or inhibits, the identification of a certain pattern, and also on the conciseness and range of dynamic or structural patterns. Taking these preconditions into account, it is plain to see that it is hardly possible to determine a pattern eo ipso, that is, independent of those variables or order parameters applied in its description and explication — which are, of course, in turn dependent on the theory preferred. It is in fact a process of coevolution: The explanans, the pattern in question, and the explanandum, the model of the nonlinear interrelations between the relevant macroscopic variables or order parameters and the control parameters, determine each other. This process of coevolution is based on the reciprocal specification of (a) the patterns by means of adequate methods, especially the collecting of time-serial data, and (b) the model applied. As already proposed by Schiepek (1986, pp. 118 ff.) with respect to the method of idiographic systems modeling, this can be viewed as a process of "dialectic problem solving" (Dörner 1976). If one takes into consideration the fact that the clinical approach to determining "patterns" — whether the intention be of a scientific, practical or therapeutic nature — always takes place in the context of concrete action and communication, of data collection, and of purposeful interaction, it becomes clear that this dialectic process of problem-solving takes on the form of a perception-action cycle (Turvey, Carello & Nam-Gyoon Kim 1990). This perception-action cycle illustrates how perception and performatory action combine in a synergistic way (see Fig. 6).

In the terminology of yet another approach, the process of the reciprocal "determination" of pattern and model is considered as the

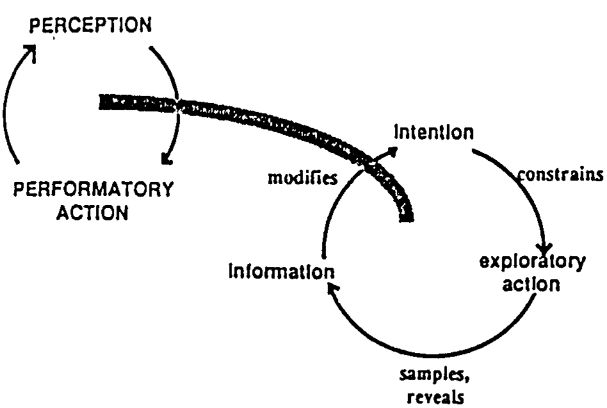

Fig. 6: The perception-action cycle. The main cycle revolves around performatory activity. Nested within the main cycle is a cycle that revolves around exploratory activity, such as adjusting and moving organs of sensitivity. In the course of several perception-performatory activity cycles one can imagine many more perception-exploratory activity cycles. Perception-exploratory activity cycles comprise intentional states guiding exploratory states, sampling informational states, and modifing intentional states. (from Turvey, Carello & Nam-Gyoon 1990, p. 279)

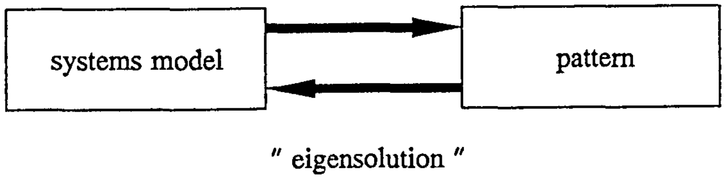

Fig. 7: Pattern identification (generation of data, pattern recognition) and model building (hypothesizing, explanation) as a recursively interrelated process, at best converging towards a stable attractor ("eigensolution").

generation of an "eigensolution" (von Foerster 1985). In Krohn and Küppers' (1989) view, the production of scientific evidence is the result of an "eigensolution" which is generated during the research process via the recursive interrelations existing between our collecting data, hypothesizing or theorizing (interpreting data), and developing appropriate methods. This approach leads one to see the generating of an "eigensolution" of pattern and model determination as the result of a process of cognitive and social self-organization (see Fig. 7).

Arriving at an "eigensolution" is facilitated by three conditions. First, biopsychosocial systems themselves reduce complexity via self-organization by creating order parameters which render structural and dynamic patterns more concise. Second, psychologists and psychiatrists, whose profession it is not only to recognize patterns but also to supplement missing links in order to get a grasp of the overall patterns, usually have an eye for relevant patterns, which is trained through daily practical work. Third, there are different methods available for developing models of complex dynamic processes. These are (a) the collection of multiple time-serial data by means of adequate measures; (b) the analysis of these data by means of adequate mathematical methods such as auto- and cross-correlational analysis, ARIMA models, Fourier analysis and, especially, the analysis of dimensionality (e.g. Grassberger & Procaccia 1983; Steitz et al., this volume) which provides information about the presence of chaotic processes and their fractal dimensionality, which in turn indicates how many variables (dimensions) are required in order to generate a specific (chaotic) time series; and (c) the building of idiographic or theoretical systems models (Schiepek 1986) which provide the necessary basis for generating mathematical models.

As has been shown, it is quite possible to develop explanatory models for those types of patterns with which we are concerned in psychological synergetics, namely dynamic patterns in the form of time-serial or process data. Factors which contribute to a reduction in the usefulness of the data collected are noise and error of measurement, an inadequate length of of time-series as well as an inadequate level of resolution of the measuring instruments. Given the declared empirical approach of psychological synergetics, the amount of work to be done on methodology in order to achieve its aim of overcoming these restrictions should not be underestimated.

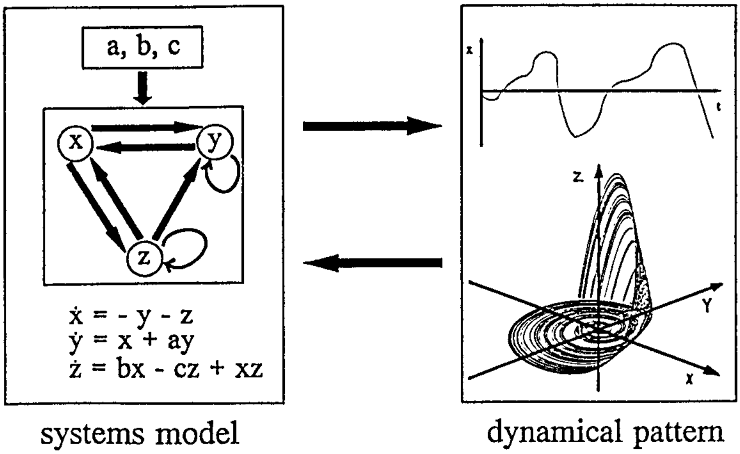

Fig. 8: The relation of systems model and pattern at the macroscopic level. The systems model is illustrated as an interrelated structure of the macroscopic variables and as a system of equations; the dynamic pattern is given as (x;t) diagram and as phase space illustration. The illustration shows the strange Rössler attractor with its pertinent system of equations. It contains 3 variables and one quadratic nonlinearity (see Rössler 1976; Nicolis & Prigogine 1987).

Fig. 8 illustrates the relationship between the dynamic pattern and its model, comprising the system's macroscopic variables (order parameters) and their interactions and autorecursive interrelations. These are given in the form of a graphic structural model, on the one hand, and as a system of difference equations, on the other. The example given here shows the system of variables pertinent to the Rössler attractor (Rössler 1976). It consists of three variables (x, y, z) and three control parameters a, b, and c. This system can be fully described by means of the three interconnected equations given. The solution resulting from these equations when specific initial conditions and parameter values are inserted shows the system dynamics (as to the theory of nonlinear dynamic systems see Bergé, Pomeau & Vidal 1984; Thompson & Stewart 1986; Schuster 1988). Any modification of the values of the initial conditions or the parameters may decisively determine the course of the resulting dynamics. There is a great chance of creating a system showing chaotic dynamics for larger systems of variables: Only three variables together with one nonlinearity (Poincaré-Bendixon theorem) will suffice in the case of continuous maps, as is shown for example by the chaotic Rössler system. Systems of one or two variables are sufficient to create chaotic dynamics in the case of discrete maps (as an example for a one-dimensional system see the logistic map; for two-dimensional systems see the Hénon map).

The systems concept of interrelated variables offers a decisive advantage in opening the way towards dynamic considerations since the dimension of time is introduced into the analysis. This presents a sharp contrast to static, structural systems concepts. Furthermore, it is convenient to conceptualize systems via interrelated variables, as mathematical procedures are available for the description, analysis, simulation and classification of the behavior of these systems. A translation of terms used in cybernetics is also possible. Input-output relations may be converted into functions, and concepts such as feedback control system, equilibrium conditions, stability and instability can also be adapted to the theory of dynamic systems.

In addition, the number of variables, their initial values, and the type of interactions between them can be determined specifically in each case so as to take into account theories and empirical evidence for the scientific field to the greatest possible extent (compare the method of idiographic systems modeling, Schiepek 1986). It is as a result of these possibilities that the conceptualization of systems via variables is often used in simulations. The present volume gives several examples: Simulation by means of difference equations (Schiepek, Schoppek & Tretter; Kriz; Tschacher, Brunner & Schiepek), differential equations (an der Heiden), and production systems (Schaub & Schiepek). Another possible way of simulating the dynamics of complex systems lies in applying the approach of connectionism, which is a result of the research on artificial intelligence (Haken, this volume; Znoj, this volume; Schaub & Schiepek, this volume). The connectionist approach goes beyond that of viewing systems as constituted by macroscopic variables, in as far as the former explains properties of pattern formation (self-organization) out of a complex microscopic level.

To summarize, the following steps are to be taken in modeling within the framework of psychological synergetics:

1) Choosing the desired area of investigation (e.g. intrafamiliar communication, development of intragroup structures, dynamics of etiological processes, therapy process research, epidemiology, perception, coordination of perception and action, etc.), along with the qualitative identification of patterns in this field. The laws of gestalt perception naturally play an important part here (see Stadler & Kruse 1986).

2) Method-guided description and, if possible, a collection of quantitative data about the dynamic pattern (via time series or coding schemes, for example).

3) Systems modeling. This implies (a) selecting adequate macroscopic variables or order parameters and (b) stating hypotheses concerning the interactions and autorecursive interrelations of the variables. The hypotheses must, of course, be based on a profound knowledge of empirical evidence and theories concerning the area of investigation. A detailed description of the method of systems modeling is given by Schiepek (1986).

4) Simulation by means of systems of nonlinear equations.

5) Testing of the model and comparison with empirical data. Possible ways of testing the model include examinations of its internal logical consistency and specific modifications of the simulated system

corresponding to the hypotheses applied (for example by modifying certain parameter values in accordance with prognoses stemming from certain hypotheses). This enables the system's behavior, as it results from the simulation, to be assessed on the basis of theoretical assumptions and with reference to the behavior of the actual (empirical) system under comparable conditions.

Simulations have to prove their worth, especially when compared to empirical systems. Further mathematical analyses, such as auto- or cross-correlograms, Fourier analysis (power spectra), and the determination of indicators of the chaotic dimensionality within the pattern in question (correlational dimension, Lyapunov exponent, Kolmogorov entropy), also serve to provide a comparison of the time-serial data obtained via simulation and through empirical data collection.

It is now the task of clinical psychology and psychiatry, utilizing the methods devised by psychological synergetics, to obtain a more profound understanding of self-organization and nonlinear dynamic processes effective in different systems.

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References

Akiskal HS, McKinney WT (1975) Overview of Recent Research in Depression, Integration of ten Conceptual Models into a Comprehensive Clinical Frame. Arch Gen Psychiatry 32: 285-295

American Psychiatric Association (1987) Diagnostic and Statistical Manual of Mental Disorders. Third Edition. APA, Washington DC

Barthes R (1977) Fragments d'un discours amoureux. Éditions du Seuil, Paris

Baumann U, Perrez M (Hrsg) (1990) Klinische Psychologie. 2 Bde. Huber, Bern

Bergé P, Pomeau Y, Vidal C (1984) L'Ordre dans le Chaos. Hermann, Paris

Birbaumer N, Schmid RF (1990) Biologische Psychologie. Springer, Berlin

Bischof N (1990) Phase Transitions in Psychoemotional Developement. In: Haken H, Stadler M (Eds) Synergetics of Cognition. Springer Series in Synergetics, Vol. 45. Springer, Berlin, pp 361-378

Blaser A (1977) Klinische Urteilsbildung. Huber, Bern

Brown GW, Harris TO, Peto J (1980). Die Kausalbeziehung zwischen lebensverändernden Ereignissen und psychischen Störungen. In: Katschnig H (Hrsg) Sozialer Streß und psychische Erkrankung. Urban & Schwarzenberg, München, S 214-237

Bruner JS, Postman L (1949) Perception, Cognition, and Behavior. Journal of Personality 18: 14-31

Burlingame GM, Fuhriman A, Barnum K, Lyman R (1991) Deterministic Chaos in Group Psychotherapy Interaction: An Illustration. Paper presented at the Society for Psychotherapy Research 22nd Annual Meeting, July, 1991, Lyon, France

Caspar F (1989) Beziehungen und Probleme verstehen. Eine Einführung in die psychotherapeutische Plananalyse. Huber, Bern

Caspar F, Grawe K (1989) Weg vom Methoden-Monismus in der Psychotherapie. Bulletin der Schweizer Psychologen 1989, Nr. 3: 6-19

Dohrenwend BS, Dohrenwend BP (1981) Socioenvironmental Factors, Stress and Psychopathology. American Journal of Community Psychiatry 9): 128-159

Dörner D (1976) Problemlösen als Informationsverarbeitung. Kohlhammer, Stuttgart

Ekman P, Friesen WV (1978) Manual for the Facial Action Coding System. Consulting Psychologists Press, Palo Alto

Foerster H von (1985) Sicht und Einsicht, Vieweg, Braunschweig

Freeman WJ (1990) On the Problem of Anomalous Dispersion in Chaoto-Chaotic Phase Transitions in Neural Masses, and Its Significance for the Management of Perceptual Information in Brains. In: Haken H, Stadler M (Eds) Synergetics of Cognition. Springer Series in Synergetics, Vol. 45. Springer, Berlin, pp 126-143

Fuhriman A, Burlingame GM (1991) Chaos: Emerging Developmental Patterns in Process Research. Paper presented at the Society for Psychotherapy Research 22nd Annual Meeting, July, 1991, Lyon, France

Grassberger P, Procaccia I (1983) Measuring the Strangeness of Strange Attractors. Physica 9 D: 189-208

Haken H (1983a) Synergetics. An Introduction. Springer Series in Synergetics, Vol.1. Springer, Berlin (3.Aufl.)

Haken H (1983b) Advanced Synergetics (Instability Hierarchies of Self-Organizing Systems and Devices). Springer Series in Synergetics, Vol. 45. Springer, Berlin (3. Aufl)

Haken H (1988) Information and Self-Organization: A Macroscopic Approach to Complex Systems. Springer Series in Synergetics, Vol. 40. Springer, Berlin

Haken H (1989) Synergetik: Vom Chaos zur Ordnung und weiter ins Chaos. In: Gerok W (Hrsg) Ordnung und Chaos in der unbelebten und belebten Natur. S Hirzel, Wissenschaftliche Verlagsgesellschaft, Stuttgart, S 65-75

Haken H (1990a) Synergetik. Eine Einführung. Springer, Berlin

Haken H (1990b) Synergetics as a Tool for the Conceptualization and Mathematization of Cognition and Behavior - How Far Can We Go? In: Haken H, Stadler M (Eds) Synergetics in Cognition. Springer Series in Synergetics, Vol. 45. Springer, Berlin, S 2-31

Haken H, Graham R (1971) Synergetik - Die Lehre vom Zusammenwirken. Umschau 6: 191

Haken H, Stadler M (Eds) (1990) Synergetics of Cognition. Springer Series in Synergetics, Vol. 45. Springer, Berlin

Hautzinger M, de Jong-Meyer R (1990) Depressionen. In: Reinecker H (Hrsg) Lehrbuch der Klinischen Psychologie. Hogrefe, Göttingen, S 126-165

an der Heiden U, Roth G, Schwegler H (1985) Die Organisation der Organismen: Selbstherstellung und Selbsterhaltung. Funkt Biol Med 5: 330-346

Horowitz MJ (1987) States of Mind. Plenum Press, New York

Katschnig H (Hrsg) (1980) Sozialer Streß und psychische Erkrankung. Urban & Schwarzenberg, München

Kelso J (1990) Phase Transitions: Foundation of Behavior. In: Haken H, Stadler M (Eds) Synergetic of Cognition. Springer Series in Synergetics, Vol. 45. Springer, Berlin, pp. 249-268

Köhler W (1920) Die physischen Gestalten in Ruhe und im stationären Zustand. Vieweg, Braunschweig

Köhler W (1940) Dynamics in Psychology. Liveright, New York

Kriz J (1985) Grundlegende Aspekte systemischer Therapien. In: Kriz J Grundkonzepte der Psychotherapie. Urban & Schwarzenberg, München, S 227-241

Kriz J (1990) Synergetics in Clinical Psychology. In: Haken H, Stadler M (Eds) Synergetics of Cognition. Springer Series in Synergetics, Vol. 45. Springer, Berlin, pp 393-404

Krohn W, Küppers G (1989) Die Selbstorganisation der Wissenschaft. Suhrkamp, Frankfurt

Kruse P, Stadler M (1990) Stability and Instability in Cognitive Systems: Multistability, Suggestion, and Psychosomatic Interaction. In: Haken H, Stadler M (Eds) Synergetics of Cognition. Springer Series in Synergetics, Vol. 45. Springer, Berlin, pp. 201-215

Lewinsohn PM, Hoberman H, Teri L, Hautzinger M (1985) An Integrative Theory of Depression. In: Reiss S, Bootzin RR (Eds) Theoretical Issues in Behavior Therapy. Academic Press, Orlando, pp 331-359

Lilli W (1978) Die Hypothesentheorie der sozialen Wahrnehmung. In: Frey D (Hrsg) Kognitive Theorien der Sozialpsychologie. Huber, Bern, S 17-46

Luhmann N (1984) Soziale Systeme. Grundriß einer allgemeinen Theorie. Suhrkamp, Frankfurt am Main

Mahoney MJ (Eds) (1980) Psychotherapy Process. Current Issues and Future Directions. Plenum Press, New York

Markowitz J (1991) Referenz und Emergenz: Zum Verhältnis von psychischen und sozialen Systemen. Systeme (Interdisziplinäre Zeitschrift für systemisch orientierte Forschung und Praxis in den Humanwissenschaften) 5: 22-46

Maturana HR (1982) Erkennen: Die Organisation und Verkörperung von Wirklichkeit. Vieweg, Braunschweig

Minuchin S (1974) Families and Family Therapy. Harvard University Press, Cambridge
Nicolis G, Prigogine I (1987) Die Erforschung des Komplexen. Piper, München
Nicolis JS (1986) Dynamics of Hierarchical Systems. An Evolutionary Approach. Springer Series in Synergetics, Vol. 25. Springer, Berlin
Reinecker H (1990a) Lehrbuch der Klinischen Psychologie. Hogrefe, Göttingen
Reinecker H (1990b) Forschungsprobleme in der Klinischen Psychologie. In: Reinecker H (Hrsg) Lehrbuch der Klinischen Psychologie. Hogrefe, Göttingen, S 25-44
Revenstorf D (1985) Nonverbale und verbale Informationsverarbeitung als Grundlage psychotherapeutischer Intervention. Hypnose und Kognition 2(2): 13-35
Revenstorf D (1990) Zur Theorie der Hypnose. In: Revenstorf D (Hrsg) Klinische Hypnose. Springer, Berlin, S 79-99
Rössler OE (1976) An Equation for Continous Chaos. Phys Lett 57A: 397-398
Rosenhan DL (1973) On Being Sane in Insane Places. Science 179: 250-258
Schiepek G (1986) Systemische Diagnostik in der Klinischen Psychologie. Psychologie Verlags Union, München Weinheim
Schiepek G (1990) Selbstreferenz in psychischen und sozialen Systemen. In: Kratky K, Wallner F (1990) Grundprinzipien der Selbstorganisation. Wissenschaftliche Buchgesellschaft, Darmstadt, S 182-200
Schiepek G (1991) Systemtheorie der Klinischen Psychologie. Vieweg, Braunschweig
Schiepek G, Schaub H (1991) Als die Theorien laufen lernten... Computersimulation einer Depressionsentwicklung. In: Schiepek G: Systemtheorie der Klinischen Psychologie. Vieweg, Braunschweig, S 221-305
Schmid GB (1991) Chaos Theory and Schizophrenia: Elementary Aspects. Psychopathology 24: 185-198
Schuster HG (1988) Deterministic Chaos. An Introduction. VCH Verlagsgesellschaft, Weinheim
Schwegler H (1978) Sind Katastrophen vorhersehbar? - Geometrische Modelle für sprunghafte Veränderungen in Natur und Gesellschaft. Jahrbuch der Wittheit zu Bremen XXII: 181-198
Stadler M, Kruse P (1986) Gestalttheorie und die Theorie der Selbstorganisation. Gestalttheory 8: 75-98
Stadler M, Kruse P (1990) The Self-Organization Perspective in Cognition Research: Historical Remarks and New Experimental Approaches. In: Haken H, Stadler M (Eds) Synergetics of Cognition. Springer Series in Synergetics, Vol. 45. Springer, Berlin, pp 32-52
Stegmüller W (1973) Theorie und Erfahrung, Zweiter Halbband: Theorienstrukturen und Theoriendynamik. Springer, Berlin

Strauss JS (1989) Intermediäre Prozesse in der Schizophrenie: zu einer neuen dynamisch orientierten Psychiatrie. In: Böker W, Brenner HD (Hrsg) Schizophrenie als systemische Störung. Huber, Bern, S 35-50

Teubner G (1990) Hyperzyklus in Recht und Organisation. Zum Verhältnis von Selbstbeobachtung, Selbstkonstitution und Autopoiese. In: Krohn W, Küppers G (Hrsg) Selbstorganisation: Aspekte einer wissenschaftlichen Revolution. Vieweg, Braunschweig, S 231-264

Thompson J MT, Stewart HB (1986) Nonlinear Dynamics and Chaos. Geometrical Methods for Engineers and Scientists. Wiley, Chichester

Tschacher W (1990) Interaktion in selbstorganisierenden Systemen. Asanger, Heidelberg

Turvey MT, Carello C, Nam-Gyoon K (1990) Links Between Active Perception and the Control of Action. In: Haken H, Stadler M (Eds) Synergetics of Cognition. Springer Series in Synergetics, Vol. 45. Springer, Berlin, pp 269-295

Wehr TA, Goodwin FK (1979) Rapid Cycling in Manic-Depressives Induced by Tricyclic Antidepressants. Arch Gen Psychiatry 36: 555-559

Weidlich W Haag G (Eds) (1983) Concepts and Models of a Quantitative Sociology. Springer Series in Synergetics, Vol. 14. Springer, Berlin

Wertheimer M (1912) Experimentelle Studien über das Sehen von Bewegung. Z Psychol 61: 165-292

Wertheimer M (1923) Untersuchungen zur Lehre von der Gestalt II. Psychol Forsch 4: 301-350

Willke H (1983) Methodologische Leitfragen systemtheoretischen Denkens. Annäherung an das Verhältnis von Intervention und System. Z system Ther 1(2): 23-37

Willke H (1989) Systemtheorie entwickelter Gesellschaften. Juventa, München