Research in the Field of Social Work

A Longitudinal Analysis of Long-Term Psychosocial Care Cases and A Computer Simulation Game on Social Working Practice

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1 Introduction

In the past few years, concepts stemming from the theory of non-linear dynamic systems, which was first established in the fields of mathematics and physics (e.g. Haken 1990a), have been transferred to the social sciences with increasing frequency (e.g. Schiepek & Tschacher 1992, Weidlich & Haag 1983, Haken 1990b, Tschacher et al. 1992). Despite sound theoretical knowledge about dynamic systems, empirical analyses are rare (e.g. Schiepek et al. 1997). Furthermore, there are only very few concepts dealing with practical consequences of the theory (e.g. Vester 1999, Schiepek & Strunk 1994). Our poster attempts to cover both of these hitherto neglected aspects: First, an empirical study based on long-term psychosocial care cases tries to identify patterns characteristic for non-linear dynamic systems. Second, we developed a computer simulation game on social working practice in order to close the gap between theoretical concepts on dynamic systems and their practical consequences.

2 Theoretical Background

Simple cause-effect principles underlie both most scientific findings and everyday decision-making processes. In particular, research about the genesis of deviant adolescent or adult behaviour is mostly based on a theoretical model that can be defined as follows (for an overview see Silbereisen & Kastner 1987):

Deviant Behaviour = VPS (Vulnerable Personality Structure)
plus
E (Environment)

Despite the usefulness of such explanatory models for fundamental research on developmental psychology and prevention concepts, the benefits for practical casework are limited. Stating that a father is always drunk due to his personality structure and permanent lack of money cannot contribute to improving matters if one assumes that the environment is given and that its consequences are always the same. Therefore, social casework nowadays often uses elements derived from systemic and solution focused therapy (e.g. Ludewig 1992). The main point of these concepts is to conceive a family and their problems as social systems (e.g. Luhmann 1984), playing their own game of reconstructing their private reality far beyond the rules of simple cause-effect principles. But social systems theory is much more of an epistemological viewpoint than a tutorial for empirical research. Most of the main conclusions from social systems theory dealing with social systems as non-trivial systems (Willke 1994), can also be drawn in a more formalised way by mathematical systems theories like chaos theory, synergetics or complexity theory (e.g. Haken 1990a, Schuster 1989). Using methods and theoretical aspects from these mathematically highly formalised theories enables us to ascertain whether a system does or does not behave trivial according to the model mentioned above.

In this context, systems are understood as elements and their interrelations. These elements should not be seen as “rigid components” but rather as variables. The interrelations between the elements define the way in which changes in the value of the elements are reflected on and amongst each other. These relations may be of linear or nonlinear nature, but even a minimum of three elements

interacting with at least one nonlinear relation will result in a variety of highly complex dynamics. In many cases, the system behaviour cannot be predicted or controlled for a long period of time. Although such a chaotic behaviour is not predictable, it follows a complex inner order. During the last decades deterministic chaos has been demonstrated in many phenomena (e.g. population dynamics: Feigenbaum 1978; chemical clocks: Prigogine & Stengers 1986; brain-wave activity: Elbert et al. 1994; hormonal processes: Heiden & Mackey 1987; dynamics of client-therapist relationship: Schiepek, Kowalik, Schütz, Köhler, Richter, Strunk, Mühlnwinkel & Elbert 1997).
The dynamics of some special social systems can be expected to be chaotic as well. But the question whether the dynamics of social casework can be seen as an unpredictable, chaotic process has not yet been explored. It is one main goal of our investigation to come up with some findings supporting the hypothesis of chaotic dynamics in social casework.

3 Longitudinal Analysis of Long-Term Psychosocial Care Cases[1]

Social casework in the field of youth welfare can be described as a care system with the aim of protecting the rights of children and adolescents to grow up in a supportive environment without risk for their health and psychological development. In real life it is often hard to identify possible future risks for a child's development without being overprotective. In some cases, social workers offer support to a child and his or her family during several years. Recurring periods of escalating problems are more or less interrupted by periods where everything seems to be going well for the child. What is the inner logic of such a long-term problem-system? Is it an artefact of an overprotective attitude caused by the helplessness of a welfare system? Does more help lead to more "normality" or does it lead to more problems? Is it possible to predict the future behaviour of a child by a "precise" identification of risk factors? These questions just represent a small fraction of the theoretical and practical problems that appear in the discussion about long-term social care cases.
In the present study we have examined six written documentations on families receiving long-term psychosocial care from social workers at the Vienna Municipal Youth Welfare Department. We were on the one hand interested in the descriptions of institutional family care in the context of youth welfare authorities and their documentation systems per se, but also in the dynamic aspects that may be hidden in these descriptions and documentations. The written documentations include detailed protocols of all formal and informal meetings between all actors belonging to the family- and help-system in question. This very time-consuming method of highly detailed case documentation was established in the early 60s as a standard operating procedure for all social workers at the Vienna Municipal Youth Welfare Department, and was closely monitored by their supervisors. This method provides us with an excellent data basis, but it also reflects the abovementioned problems stemming from the anxiety not to ignore a possible future risk.
In the following sections we will present a brief description of the methods used to identify characteristics of complex systems. One of the six cases will be presented in more detail. It is the case of Family K, receiving support at the Vienna Municipal Youth Welfare Department since the birth of their first child, a girl, up to her eighteenth year of life. The first years of the girl's life are characterised by the difficult relationship of her parents. The father is imprisoned several times for violence and serves the last (and longest) term after attacking the mother with a knife, nearly killing her. The girl develops psychosomatic symptoms; the authorities are also repeatedly notified of physical abuse. At the age of five, the girl, together with her younger brother, is placed in residential care for the duration of three years since the parents (divorced by then) have become homeless. When the girl is ten years old, her brother is once more taken into residential care. Four years later, the girl moves into a residential home after conflicts with her mother. In the following year, she is transferred to another residential home. She displays behaviour disturbances, signs of anorexia and incipient drug abuse. At the age of seventeen, she once more changes residential homes several times, which first causes her symptoms to intensify. Later, however, the symptoms begin to lessen. The girl finds a job and is able to move into her own flat with a boyfriend.

3.1 Coding

In order to make the detailed written records usable for time series analysis, we decided to concentrate exclusively on communications and to reduce information to the question of who contacted whom at which moment. Despite the fact that the early communication model of Shannon and Weaver (Shannon 1948, Shannon & Weaver 1949), from which we have taken the sender-receiver-concept, is a very limited theoretical framework for the study of social interaction (e.g. Watzlawick et al. 1969), it enables us to identify the most powerful actors within a social system by counting how often a person defines him- or herself as a sender or initiator of communication and how often a person can be seen as a receiver.

In order to convert the written documentation into a database, all relevant actors within a case were assigned a unique identifying number. In a second step the records were broken down into periods of ten days numbered for

[1] The original paper called "Sozialisationschancen und Betreuungsstrukturen" by Friedlmayer, Reznicek & Strunk won the best paper award of the German Systemic Society (Systemische Gesellschaft) in 2000.

each case starting by one, which results in approximately 36 periods per year. In a final step, a data sheet consisting of three columns was compiled for each case, with the columns consisting of 1. the numbering of periods, 2. the code of a communication initiator, and 3. the code of the receiver (see table 1 for a brief fictitious example).

The number of relevant actors (with respect to their involvement and after assigning some actors to categories like "other care systems") for the six cases varies between 11 and 15, and the time of documentation varies between 12 and 17 years. On average, a communication event occurred every seven days.

Time-Line (Numbering of Periods)	**Communications** Code of Initiator	Code of Receiver
1	9	1
1	9	2
1	9	5
1	9	4
2	0	0
3	1	9
3	5	9
4	9	10
etc.		

List of Codes:
(1) Mother
(2) Father
(3) Four Years Old Girl
(4) Siblings
(5) Father's Live-In Companion
...
(9) Social Worker
(10) Kindergarten

Table 1:
During period 1 (e.g. from 11th – 20th October, 1978) the social worker (9) contacted the mother (1), the father (2), the father's live-in companion (5), and the siblings (4) of the child concerned in the course (3). No contacts occurred in period 2 (21st – 31st October, 1978). In period 3 (1st – 10th November, 1978), the mother (1) and live-in companion (5) contacted the social worker (9). In period 4 (11th – 20th November, 1978), the social worker (9) contacted the kindergarten (10) etc.

3.2 Complex Static Structures

In order to obtain an overall picture of the six system structures, we generated quadratic matrices for each case, with rows and columns both representing all actors in identical order. The rows represent the communication initiators and the columns represent the receivers. Each cell indicates the frequency of the communications initiated by the actor corresponding to the respective row and received by the actor represented by the respective column.

Using algorithms developed by Schiepek, Reicherts and Strunk (printed in Manteufel & Schiepek 1998, S. 221ff; for a very similar method see Vester 1999) those matrices can bee analysed with regard to the overall involvement and the power of an actor in influencing others. Changing structures in time can be analysed by the same methods for both the overall matrix and separately for any period.

Figure 1 shows the system structure for two separated systems (client and helping system) for the example mentioned above. The structures were created based on the main communicative directions of the actors, according to how they were documented in the records.

3.3 Complex Dynamic Structures

In order to get comparable data for all cases, actors were pooled into three groups; the first group includes the whole family system; the second "group", the social worker in charge of the case, and the third group, the other actors of the helping system. In this manner, series of three-by-three communication matrices – one for each period – were created. By observing the changes in the relative frequencies of one of the matrix cells over time, it is possible to obtain a time series to which complexity calculations can be applied.

The dominant direction of communication for the above-mentioned case was the mother contacting the social worker. Therefore this cell was chosen for closer examination. Figure 2 shows the time series for this cell. The plot appears quite complex to the naked eye, a result that can be confirmed by various calculations.

First of all, the time series shows only limited options for linear forecasting. Later periods show hardly any correlation with earlier periods. For example, the autocorrelation function decreases quickly from a value of 0.8 for succeeding periods to 0.3 for data points being separated by only three periods. This leads to a broad frequency spectrum (see Figure 3), which also indicates that the observed process cannot be characterised by simple periodical oscillations.

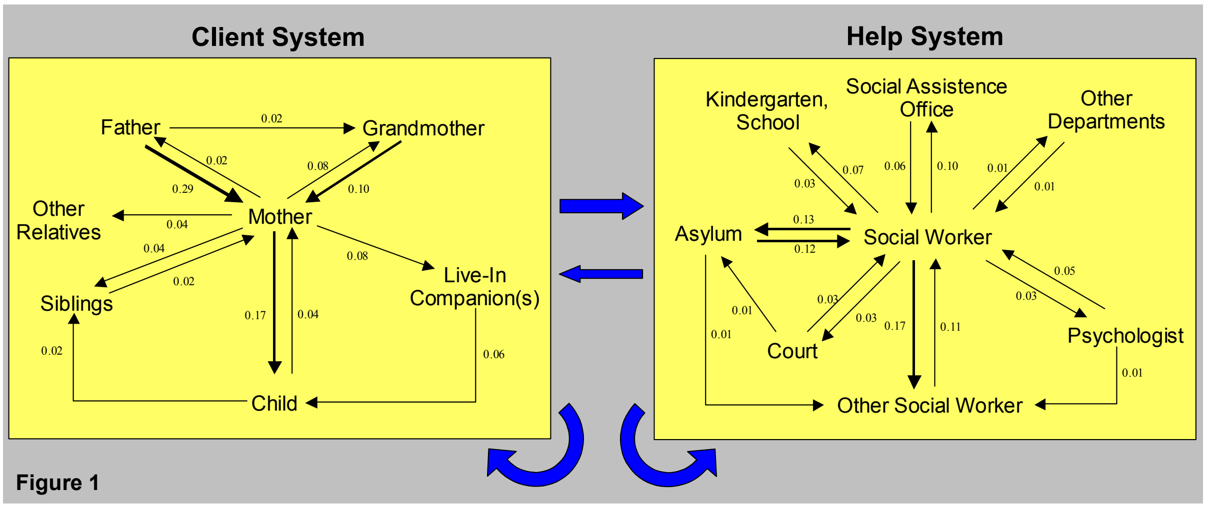

Figure 1

The process is therefore a complex one, but is it chaotic? Most of our time series are too short for applying methods that can identify deterministic chaos. There is only one algorithm described by Rosenstein et al. (1993) which seems to be useful for calculating Largest Lyapunov Exponents (LLE) with short and noisy time series (but only if the underlying system is not too complex; see Rosenstein et al. 1993). If one defines chaos as an exponential divergence of very similar system states (butterfly effect), the LLE has to be a positive value, which indeed seems to be true for the presented time series (LLE ~ 0.7 per period). However, due to the limited length of the time series, the results should not be taken as strong and convincing evidence that the underlying process is a chaotic one. The same limitations apply to the calculation of the correlation dimension (Grassberger & Procaccia 1983), which helps to shed light on the ordered structure covered by deterministic chaos (Ruelle & Takens 1971). The results for the correlation dimension (D2) calculated for the time series in figure 2 also point towards a chaotic process (D2 ~ 1.7 ± 0.24; saturation can be found from 2 dimensions up to 17).

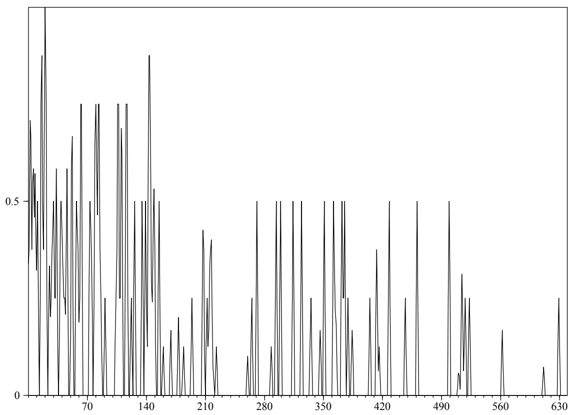

Figure 2

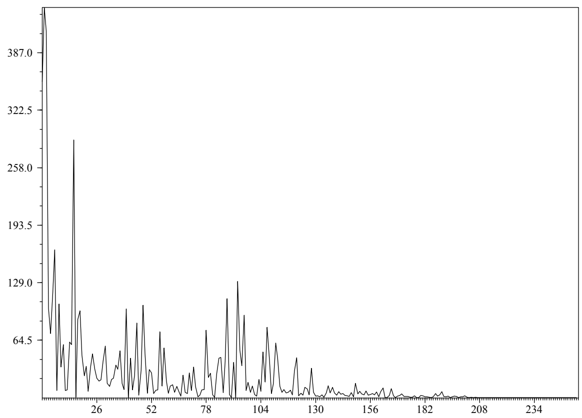

Figure 3

Apart from these sophisticated measurements, calculations based on algorithmic entropy can be applied to our data without restrictions. One of the easiest ways to calculate algorithmic entropy is to use a data compression algorithm (similar to file compression used on computers) on the data. While it is not possible to significantly compress random data, it is possible to distinguish random time series from ordered ones. We used a compression algorithm called Grammar Complexity (Rapp et al. 1991) after transforming the floating-point values of our time series into integer values ranking from 1 to 7. This step was necessary as the algorithm only works if the same values appear more than once in the data set, which is extremely unlikely for a series of rational numbers. A data set where the integers are sorted by size leads to the best compression. Applying the algorithm to the original data set shown in figure 2 results in a compression three times lower. Shuffling the data randomly further decreases possible compression: the mean compression for 200 randomly shuffled time series was even four times lower than for the sorted sequence of values. The difference in compression between the randomly sorted data and the original time series is statistically significant, suggesting that our time series is more ordered than random, but more complex than its most ordered variant. Similar results could be found for the majority of our cases: Processes of long-term social care cases can be seen as complex but not random dynamics.

4 A Computer Simulation Game on Social Working Practice

The presented findings primarily aim at creating a contribution for discussing theoretical models of linear versus non-linear cause effects and intervention planning. But even for experts in social practice such models seem to be very abstract and the new knowledge and insight these theories and models offer are often hard to transfer into practice. Hence we decided to create a computer simulation game where non linear relationships should become comprehensible, facilitating discussion about context interrelationship and non-linearity in the field of practice.

The computer simulation game on social working practice was first developed as a contribution to the so-called "Science Week @ Austria 2001", which was held from May 11th – 20th, 2001 with over 750 events, offered by universities, technical colleges, schools, scientific clubs, and businesses presenting themselves and their knowledge in a generally understandable and often humorous manner.

The simulation game allows players to slip into the role of a social worker. A simple case is presented, typical for the daily experience of social workers with families: A school reports that a 13-year-old pupil has been attending school very sporadically for several months already, and during the past month completely refused to attend classes. On the one hand, the school assumes there is a danger of delinquency due to the boy's hanging around with his friends who also play truant. On the other hand, the teachers are also afraid that his behaviour may be due to depressive withdrawal, as the boy has broken off all contact with his classmates. A social worker is assigned to the case. She talks with the boy, his parents and the school. The boy lives with his parents, who are both employed. He is their only child.

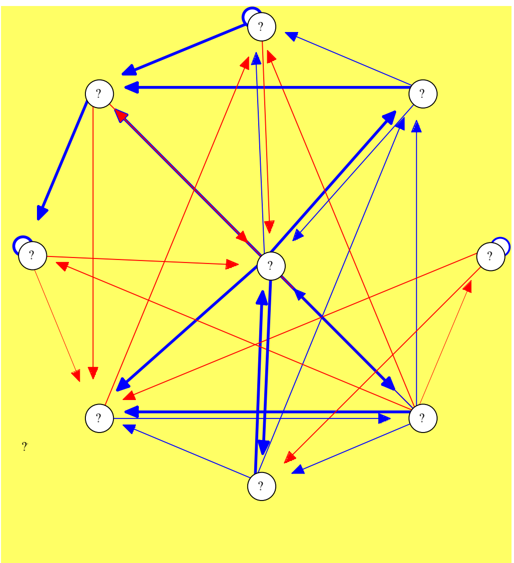

Figure 4

1 **Social Worker Measures.** The social worker measures include all of the possibilities for help which are at her disposal as the person in charge of the case. These can be problem-oriented or resource-oriented.

2 **Youth's Disposition.** The youth's disposition refers to his present state of mind: from very sad and suicidal to overestimating himself, provocative, aggressive.

3 **Youth's School Performance.** The youth's school performance describes how well he does at school.

4 **Social Worker's Workload.** The social worker's workload describes to what extent she is busy with other work. She can have sufficient time for the case in question or be totally overloaded.

5 **Mother's Attitude about the Problem.** The mother's attitude about the problem describes how she sees her son's chances. She oscillates between despair and active support.

6 **Father's Attitude about the Problem.** The father's attitude about the problem describes how he sees his son's chances. He either reacts with indifference or with severity.

7 **Parental Conflict over the Problem.** The parents argue a lot about their son's problems. If the argument escalates, one of them may threaten to divorce. However, they can also harmoniously search for solutions together.

8 **Father's Alcohol Consumption.** The father has also sought consolation in excessive drinking during previous crisis situations. If he doesn't drink much, he is usually good-natured. But he may become downright addicted to alcohol from time to time.

9 **School Climate.** The school climate describes to what extent the boy feels good at school. The climate can be pleasant and friendly or strict and restrictive, with lots of rules and regulations.

Based on this case we have built a mathematical model of nine variables interacting with each other in a complex way (the structure of the system is presented in figure 4). The game is set up in rounds. In each round the player is able to directly change the values of some of the variables in order to solve the case positively. For doing so the player needs action points, but their number is limited for each round and depends on the state of the game. After each round of intervention, the underlying mathematical model is used to calculate the development of the system for the next round. Up to a total of 10 rounds, one has the possibility to improve the situation. However, achieving this is not a piece of cake. An intervention that first seems to have a positive effect may turn out to be extremely detrimental in the long run and vice versa. Sometimes the situation turns bad very quickly and the player loses all his action points long before the game ends, or the situation might even "topple over" due to one or several variables having gotten completely out of hand.

Despite the fact that there are several ways to improve the situation, most players fail before the last round. During the Science Week, a total number of 223 games (1,445 rounds) were played and recorded by the computer (about 150 can be used for analysing intervention strategies). Although 92% of the games ended with better results than they would have if there had been no intervention at all, only 18% of the games lasted until the last round.

Generally spoken, successful players use different and flexible strategies. They do not commit themselves to just one way of intervention or the assumption of a simple dose-effect relationship, but rather try to tackle the situation with a flexible and open-minded approach.

5 Conclusion

Up to now it has not been possible to prove the presence of nonlinear dynamics and deterministic chaos in social working practice. Although the analysis of long-term care cases suggests that they display characteristics of complex dynamical systems, the results are not as convincing as we had hoped. However, we think that linking the theory of nonlinear dynamic systems with psychosocial practice is a successful approach and that the resulting conclusions are legitimate consequences of this approach.

A substantial finding of the present study lies in its support for concepts which postulate the inadequacy of linear causal explanation models and intervention planning for complex systems (e.g. Dörner 1989, Luhmann 1984, Willke 1994). The particularity of complex systems lies above all in the fact that they organise their "internal life" according to their own laws, dynamically change their "structure" and react to outside interventions according to their own internal logic. Their "elements" are not associated with each other in strict linearity but rather networked both in space and time in multiple ways. Inputs from outside do not pass straight through the system but are refracted, redirected, transposed. There is no simple, direct connection between cause and effect; causalities become erratic, processes circular, interactions and feedback are generated, which creates the dynamics of the system. Moreover, this "internal life" of the system is relatively autonomous and not directly accessible. Any attempt at modelling such behaviour according to principles of trivial (or even complex but always linear) mechanics is bound to fail.

Our experiences with using the computer simulation game as a didactical tool for teaching and discussing the behaviour of, and the intervention into, such complex systems are very positive. Players often began to rethink their beliefs about the rules driving the behaviour of a system. Analyses of misleading interventions shed light on general mistakes of intervention planning in the context of complex systems (see Dörner 1989 for examples of such mistakes).

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