Abstract

Although considerable research has been undertaken on psychosocial treatment and rehabilitation of patients with chronic schizophrenia, few studies have examined individual courses by means of repeated and frequent observation. A more dynamic view of rehabilitation might disclose patterns of response useful for both understanding and treating symptoms and disabilities associated with chronic schizophrenia. In an exploratory study, time series of 35 schizophrenia outpatients participating in a vocational rehabilitation program were examined by a relatively original quantitative approach to the identification of dynamical patterns. By using time series regression on weekly behavioral ratings, dynamical properties of mean, trend, and variability were calculated. Cluster analysis revealed five subgroups of courses: (1) stable at a high level, (2) fluctuating at a middle level, (3) at a middle level, tending toward a slight descent, (4) showing a steep descent, and (5) unstable at a low level of functioning. The subgroups varied at intake in psychopathology; in cognitive dysfunction; and in measures of self-concept, locus of control, and coping. At program end, pronounced differences were found among the subgroups in vocational reintegration. These different dynamical patterns can be understood as typical pathways linking patient characteristics to rehabilitation outcome. A broader use of dynamical designs could substantially clarify the variety of reactions of patients to psychosocial interventions.

Keywords: Psychosocial functioning, longitudinal studies, time factors, subtypes of courses, classification of courses, vocational rehabilitation, response to psychosocial rehabilitation.


Understanding a phenomenon by examining its dynamics is a basic and often successful strategy in science. The term dynamics is used in various scientific domains to designate the forces that govern movement or change over time. In psychiatry and clinical psychology, a renewed interest in dynamics, at both the phenomenological and theoretical levels, is evidenced in the growing body of empirical work applying linear and nonlinear methods to time series (Strauss 1989; Globus and Arpaia 1994; Gottschalk et al. 1995; Paulus et al. 1996; Tschacher et al. 1997). Such dynamical approaches could be especially significant in the understanding of schizophrenia, a disorder that is characterized by a diversity of possible courses (Ciompi 1980; Harding 1988). Vulnerability-stress-coping-competence models (Neuchterlein and Dawson 1984; Liberman 1986) include biological, psychophysiological, psychological, and psychosocial factors and reflect the complexity of schizophrenia. Among these variables, dynamical interactions have been proposed as an explanation for the heterogeneity in the development and time course of schizophrenic disorders (Ciompi 1989; Schiepek et al. 1992; Kupper and Hoffmann 1996; Kupper 1999). If schizophrenia is understood as a system disorder (Brenner 1989), then research on etiology, course, treatment, and rehabilitation should include dynamical approaches.

Psychological interventions and psychosocial intervention programs have proved to be of moderate general effectiveness in the treatment of schizophrenia, although there is still little empirical knowledge of their modus operandi, differential effectiveness, indication, optimal timing, and indicative variables over the course of the disorder (Bellack and Mueser 1993; Lehman 1995; Penn and Mueser 1996; Lehman et al. 1998). Longitudinal approaches using repeated and frequent observation could prove to be especially helpful in addressing these issues (Breier 1988). Although dynamical research designs are
becoming increasingly prevalent in general medical science and the neurosciences (Skinner 1993; Bélair et al. 1995), these procedures have rarely been applied to the study of psychosocial rehabilitation in schizophrenia patients. Vocational reintegration is one of the most important objectives in the psychosocial rehabilitation of the chronically mentally ill, since a considerable number of schizophrenia patients suffer from impairments in vocational functioning and low employment status. Compared with other diagnostic groups, schizophrenia patients have poorer vocational outcomes (Fabian 1992; Jacobs et al. 1992). Apart from being a critical goal in the rehabilitation of patients with schizophrenia, work can also be of considerable, enduring clinical benefit (Bell and Lysaker 1997).

To date, most studies of vocational rehabilitation have largely been confined to either the identification of predictors (e.g., Griffiths 1977; Ciompi et al. 1979; review of Anthony and Jansen 1984; Anthony et al. 1995; Hoffmann and Kupper 1997) or the evaluation of the outcome of specific rehabilitation programs (e.g., Hubschmid and Aebi 1986; Bond et al. 1995; Drake et al. 1996). Although rehabilitation has often been defined as a process (McGrory et al. 1980; Harding et al. 1987), only a few studies have investigated the specific dynamics of this process. This applies to rehabilitation in general as well as to vocational rehabilitation in particular. To our knowledge, only one study has been undertaken using a process-oriented design with frequent observation or time series analysis to evaluate the dynamics of vocational rehabilitation (Hoffmann and Kupper 1996). Most studies have reduced the process of rehabilitation to a “before and after” assessment instead of examining the patients before, during, and after. As Strauss et al. (1985) maintain, such two-point measurement may well be inadequate and misleading if the goal is to understand the longitudinal process. Strauss et al. described common patterns in the course of severe mental disorders and propounded longitudinal principles (Strauss et al. 1985; Rakfeldt and Strauss 1989; Strauss 1989). They postulated typical phases and mechanisms of interaction between the patient and the environment while stressing the active role the patient plays during this interaction. Their hypotheses were based on repeated extensive personal interviews with individual patients. Such qualitative studies have been instrumental in increasing knowledge about the factors relevant to the success or failure of the rehabilitation process, although the studies’ limitations are also apparent. Ideally, the identification of patterns should be based on both quantitative and qualitative assessment. Measurements should be made frequently, and the method employed to extract the patterns should have a statistical basis.

Thus, little is known about the dynamics of rehabilitation in schizophrenia, although gaining insight into these aspects would be of importance theoretically and could optimize intervention. In the present study, we focused on the vocational rehabilitation of schizophrenia outpatients and developed a quantitative approach for the identification of dynamical patterns. The objective was to explore the presence and importance of dynamical patterns in terms of their indicative value during the course of rehabilitation. Of further interest was their function as links between the characteristics of patients and the outcome. Three questions were addressed: First, can distinct dynamical patterns be uncovered from weekly measurements of functioning? Second, if such patterns are found, do they correspond to specific patient characteristics, such as symptomatology, cognitive dysfunction, personality, and coping style? Third, are the patterns related to the rehabilitation outcome assessed in terms of vocational status?

Methods

Study Background. The psychosocial rehabilitation program for vocational reintegration developed at the University of Bern, Psychiatric Services, has been described in detail elsewhere (Dauwalder and Hoffmann 1992). This five-phase program is designed for a maximum duration of 18 months. The first phase of assessment lasts for 2 weeks, at the end of which time patients demonstrating less than 40–50 percent of ordinary work performance are excluded. Other exclusion criteria include a high level of acute psychotic symptoms and insufficient motivation. The second phase takes place in a program-integrated workshop with a capacity for 15 participants. After approximately 6 months, during the third and fourth phases, the patients begin working in training jobs in local companies. The fifth phase is that of aftercare. From the third phase onward, job coaches provide support not only for the patients on their training jobs but also for their coworkers and immediate supervisors. Other significant aspects of the program are the social skills training group, which meets twice weekly, and monthly family therapy.

Research Participants. To date, 55 patients have attended the rehabilitation program. Thirty-five patients met DSM-III-R (American Psychiatric Association 1987) criteria for schizophrenia and two met criteria for schizoaffective disorder. Eighteen patients had other diagnoses (mainly affective disorders or personality disorders). The latter were not included in the present study, nor were two schizophrenia patients who dropped out from the program very early, allowing for only four weekly observations each. Thus, the rehabilitation course of 35 patients was analyzed in the present study. Ten out
of 35 study participants were female (29%) and the average age was 26.0, with a standard deviation (SD) of 4.0. Three participants were married, three divorced, and the rest single. The mean duration of mental disorder was 5.5 years (SD = 5.0), during which time the patients had been hospitalized an average of 2.6 times (SD = 2.2). Twenty patients (57%) had completed vocational training, four had failed to pass their final vocational examination, and only seven (20%) were unskilled. Subjects generally showed moderate levels of psychopathology as assessed by the Positive and Negative Syndrome Scale (PANSS; Kay et al. 1987). Negative symptoms (mean = 16.2, SD = 7.4) and general symptoms (mean = 30.6, SD = 8.4) were more prominent than positive symptoms (mean = 12.3, SD = 4.2). There were relatively few symptoms for each patient rated above the "moderate" level in severity (mean = 0.14 for positive symptoms, mean = 0.60 for negative symptoms, and mean = 0.66 for general symptoms).

All but one of the patients were taking neuroleptic medication during the program. The mean duration of unemployment before entering the program was 13.7 months (SD = 12.4). The mean rating of the patients on the Global Assessment of Functioning Scale (GAF, Axis V in DSM-III-R) was 44.1 (SD = 6.6). This rating indicates that the patients were seriously impaired in their social or occupational functioning. Vocational status after completion of the program was considered indicative for the outcome of rehabilitation. Outcome was scaled according to the highest phase of the program a patient attended. The assessment phase, phase 1, was completed by all 35 patients. Sixteen patients progressed no further than phase 2, training in the workshop. Four patients attained phase 3, training in a local company, but without subsequent job placement. Fifteen patients were successfully placed in competitive jobs, as specified in phase 4 of the program. At follow-up, 2 years after intake in the program, 11 patients had kept competitive employment for 6 months or longer. For the purpose of this study, the outcome for patients who progressed no further than phase 3 (training in a local company) was termed "unfavorable" (n = 20), whereas for patients attaining phase 4 (successful placement in competitive jobs), the outcome was termed "favorable" (n = 15). The weekly observations used to describe the 35 courses of rehabilitation covered the time span subjects remained in the program up to phase 4, including workshop training and eventually training in local companies. The observation time was 45 weeks on average, with a range of 14–88 weeks.

Instruments. The instruments used at intake were aimed at a comprehensive and predictive yet clinically practicable assessment. These represent the three domains of (1) psychopathology, (2) cognitive functioning, and (3) personality and coping. Psychosocial functioning was measured weekly throughout the course of rehabilitation.

Psychopathology. Psychopathology was rated using the PANSS (Kay et al. 1987). All PANSS ratings were carried out by the authors. As part of their training, assessments were validated using educational videotapes based on interviews and assessments by Kay et al.

Cognitive functioning. Cognitive measures included the German version of the Wechsler Adult Intelligence Scale (WAIS; Wechsler 1964), two series of the Benton Visual Retention Test (Benton 1974), and Brickenkamp's concentration test "d2" (Brickenkamp 1981; Brickenkamp and Zillmer 1998). The Benton Visual Retention Test measures visual perception, immediate visual memory, and visuomotor functioning, as measured by the d2 test measures selective attention using a digit canceling task. In this timed task, the subjects are presented with 14 lines, each containing 47 letters d or p in lower case. Vertical dashes are printed above or below many of the letters. The subjects are instructed to identify (cross out) those letters d that feature a total of two dashes. The time limit is 20 seconds per line. This test requires less than 10 minutes for administration. From the test "d2" the overall performance (corrected for errors) and the percentage of errors were used in this study. The WAIS was used in this study to control for signs of general cognitive impairment, while the other two tests were included to screen for cognitive dysfunctions that could adversely affect the vocational capabilities of patients suffering from chronic schizophrenia. Both attention and visuomotor functioning, as measured by the d2 test, and visual memory, as assessed by the Benton visual retention test, are diminished in schizophrenia patients, deficits being related to but not identical with negative symptoms (Strauss 1993; Schreiber et al. 1995). Dysfunctions in visual memory may be of particular importance in schizophrenia patients showing a chronic course of the disorder (Goldberg et al. 1993; Sackin et al. 1994). Brekke et al. (1997) found that deficits in complex visuospatial construction skills were associated with poorer work functioning.

Personality and coping. In chronic psychotic disorders, psychological factors related to demoralization and helplessness could play an important mediating role, inhibiting the patients' activity during rehabilitation. Dysfunctional beliefs and coping styles might be related to both personality factors that preceded the onset of the disorder and to the experience of chronic schizophrenia as an apparently uncontrollable situation (Birchwood et al. 1993). Therefore self-concept (Frankfurt Self-Concept Scale [FSKN]; Deusinger 1986), locus of control (IPC Scales by Levenson 1974; the German version by
Krampen 1981 was used), and coping (Coping With Stress Questionnaire, Janke et al. 1985) were included in the assessment as potentially important psychological variables. Self-concept was assessed by the FSKN, constructed by Deusinger (1986). The FSKN distinguishes ten different self-concepts representing four dimensions of the self: competence and achievement, self-esteem, affects and sensibility, and a psychosocial dimension. The FSKN is a self-report instrument containing 78 items with a six-point Likert scale format ranging from “fits very well” to “does not fit at all.” In accordance with the studies of Deusinger, in our sample all ten scales were highly intercorrelated (Pearson’s r ranged from 0.43 to 0.84), and internal consistency was excellent (Cronbach’s α = 0.94). These results legitimized our using the sum score of the ten scales as an overall measure of self-concept. Locus of control was assessed by Krampen’s IPC Scale (1981), the German version of the internal (I), powerful others (P), and chance (C) scales of Levenson (1974). These three scales consist of eight items in a six-point Likert scale format, ranging from “completely wrong” to “absolutely correct.” The scales measure the degree to which a person perceives events in his or her life as being a consequence of his or her own actions, under the control of powerful others, or determined by chance. The belief in external control by chance (scale C, fatalism), as measured on the IPC Scale, was included in this study. Coping was assessed by a self-report questionnaire on stress-coping strategies developed by Janke et al. (1985). The questionnaire originally contained 19 subscales of different coping strategies, each comprising six items in a five-point Likert scale format. In this study, a factor that was identified in earlier research work (Hoffmann et al., in press) and termed the “depressive-resigned coping factor” was included. This factor comprises eight subscales such as self-pity, resignation, and brooding. The internal consistency of this factor in the data used in this study proved to be high (Cronbach’s α = 0.91).

Psychosocial functioning. For the weekly observations during the course of rehabilitation, we used the Nurses’ Observation Scale for Inpatient Evaluation (NOSIE) (Honigfeld et al. 1976, 1986). The NOSIE is easy to rate and sensitive to change in patients’ behavior, in terms of both personal and social functioning and symptomatology. The NOSIE comprises 30 items that are scored on a five-point Likert-format frequency scale from “never” to “always” and assesses seven factors: social competence, social interest, personal neatness, irritability, retardation, depression, and manifest psychosis. For the purpose of this study, the global NOSIE sum score (sometimes referred to as “total assets”; Honigfeld et al. 1976) was used as a representative measurement of the level of functioning during rehabilitation. According to a recommendation of Honigfeld et al. (1976), scores were totaled and rescaled linearly to prevent negative values. This transformation, which yields global NOSIE scores in a possible range from 18 to 256, does not influence results from correlational or inferential statistics.

We chose the NOSIE because it is sensitive to change, relies on direct observations by staff members over the span of a few days, and has a comparatively simple rating procedure. In support of the choice of the NOSIE, a preliminary study showed that the NOSIE factors correlated highly with ratings of work performance and independent clinical ratings of global adaptation (r = 0.70-0.94). In the data used in this study, the NOSIE global score correlated strongly (r = 0.68, p < 0.0001) with a concurrently measured 11-point Likert scale of global vocational competence that was designed for this study and ranged from “very poor” to “excellent.” At the vocational rehabilitation unit, NOSIE ratings were performed weekly by the same two staff members, who reached consensus on the scores. The ratings from these two staff members represent the majority (63%) of all ratings used in the study. Generally, good-to-excellent interrater reliabilities are reported for global NOSIE scores (Honigfeld et al. 1976). For confirmation, interrater reliability was tested twice for the global NOSIE score by means of independent ratings performed by the two staff members. Using intraclass correlations according to Shrout and Fleiss (1979), reliability between these two raters proved to be good (intraclass correlation coefficient [ICC] = 0.80, ICC = 0.88).

At the training jobs, weekly ratings were performed by the supervisors who had been introduced to the rating procedure by rehabilitation staff members. No on-the-job formal testing of reliability was possible for reasons of practicability. However, deviations from the most recent ratings at the vocational rehabilitation unit (e.g., by two or more points in the five-point NOSIE items) were discussed with the supervisors at the training jobs.

Internal consistency for the global NOSIE score was satisfactory (Cronbach’s α = 0.80). Each of the 30 items correlated significantly and consistently (r = 0.15-0.55) with the NOSIE sum score. Items indicating irritability or cognitive deficits showed the highest correlations with the sum score. In terms of the classical subscale factors of the NOSIE (Honigfeld et al. 1976), the NOSIE subscale “social competence” contributed most to the NOSIE global score. This subscale includes items related to cognitive deficits (e.g., NOSIE item 13, “Has trouble remembering,” or NOSIE item 24, “Has difficulty completing even simple tasks on his own”). Items from the NOSIE subscale “irritability” (e.g., NOSIE item 11, “Refuses to do ordinary things expected of him”) were also among
those items that correlated most with the global score. Conversely, items reflecting overt signs of positive symptoms and depression, which were rare in the present sample of stabilized patients, correlated least with the global NOSIE score.

Procedure. Our quantitative approach to the identification of dynamical patterns had four steps: (1) selection of the variable(s), (2) definition and calculation of the dynamical properties that seem relevant to the process under study, (3) identification of typical dynamical patterns by cluster analysis, and (4) comparison of the clusters regarding their characteristics before and after the process. With this last step, we intended to test the relevance of the dynamical patterns found, using variables that have proved to be important for reference.

Selection of the variable(s). The global NOSIE score was used as a general indicator of functioning.

Definition and calculation of the dynamical properties. To represent the time series, three basic parameters of each course were calculated: the mean, a linear trend, and the amount of random fluctuation or variability surrounding the trend (figures 1 to 5). These properties are partially analogous to Thiel's (1966) classical decomposition of sources of error in dynamical models—differences in the means, differences in the variances, and irregular error. They were chosen because they yield a simple yet potentially meaningful description of a series, as all three have clinical significance in terms of level of functioning, the direction of change during rehabilitation, and the stability of behavior. We used these parameters as the basis for the identification of dynamical patterns. All parameters were calculated individually for each patient. The mean was calculated as a first parameter. As a second parameter we estimated a linear trend using a time series regression approach (autoregression procedure from SAS/ETS, SAS 1993). With this method, supplementary to trend and intercept as found in classical regression analysis, an autoregressive term was estimated to correct for serial dependency in the data. For all patients, a maximum likelihood estimate of an autoregressive parameter of order one was used. A uniform correcting procedure is desirable in the analytical strategy used. Upon consulting the results of a backward elimination procedure of non-significant parameters, size one of the model proved to be most appropriate for almost all of the series. The third parameter, the amount of fluctuation surrounding the trend model, was estimated as the root mean squared error.

Figure 1. Case example (Peter A.) from the high-level subgroup: Raw scores, mean, trend, and variability

NOSIE

255

245

235

225

215

205

195

185

175

0 5 10 15 20 25 30 35 40 45 50 55 60

Weeks
Figure 2. Case example (Marianne B.) from the middle-level/fluctuating subgroup: Raw scores, mean, trend, and variability

Figure 3. Case example (Patrick C.) from the middle-level/slight descent subgroup: Raw scores, mean, trend, and variability
Figure 4. Case example (Daniel D.) from the steep descent subgroup: Raw scores, mean, trend, and variability

Figure 5. Case example (Markus E.) from the low-level subgroup: Raw scores, mean, trend, and variability
(RMSE). No correction from an autoregressive term was used on the RMSE, as this would have led to considerable complications in interpreting the resulting deviation from the trend.

Identification of typical dynamical patterns by cluster analysis. The three parameters were examined for similarities in subgroups of patients by using cluster analysis. As pointed out by Backhaus et al. (1987), in cluster analysis there are no general rules to determine a priori the adequacy of a given sample size in relation to the number of variables to be included. However, from a practical point of view, the number of variables should yield a favorable ratio of observations per variable. Therefore, a rather restrictive selection of variables is advisable. The cluster analysis was performed according to guidelines suggested by Backhaus et al. (1987). First, a single-linkage analysis was performed to detect outliers and to ensure the reliability of Ward’s method cluster analysis based on Euclidean distances. For this analysis, the parameters were standardized to prevent overrepresentation of one variable because of its absolute values. The number of clusters was estimated using the graphic representation of joining distances.

Comparison of the clusters. The relationships between the dynamical patterns, the variables at intake, and the outcome were explored using frequency analyses and analyses of variance. This step was important for the interpretation of the results as well as for the validation of the whole approach: dynamical patterns that were uncorrelated to standard clinical variables at intake and also uncorrelated to outcome could very well indicate a failure to catch the important features of the process under study. All calculations were performed using SAS/STAT (SAS 1989) and SAS/ETS (SAS 1993) software.

Results

Cluster Analysis. The single-linkage analysis clearly identified one outlier. This patient (female, 29 years of age, suffering from schizophrenia, paranoid type) initially showed a high level of functioning in the workshop, followed by a fast decline in performance and a further course on an extremely low level. Clinically, there were no indications of an increase in positive symptoms related to this rapid decline in performance. Considering the patient’s unfavorable global level of functioning at entry (GAF = 35) and the very high level of negative symptoms (PANSS negative symptom score = 29), the high level of functioning during the first weeks of the rehabilitation program may have constituted an initial response that was not sustainable over time owing to the patient’s limited resources. In accordance with our strategy for analysis, this atypical case was excluded from further calculations, thereby reducing the number of patients to 34 for all subsequent analyses.

Variables entering a cluster analysis should not be redundant, as indicated by correlations of Pearson’s \( r > 0.9 \) (Backhaus et al. 1987). The correlations among the three clustering variables (mean, trend, and irregular fluctuation) were low to moderate, and all proved to be clearly below the limit of \( r = 0.9 \), thus justifying their inclusion in the cluster analysis. Pearson’s correlation between trend and variability was \( r = -0.12 \) (not significant [NS], \( n = 34 \)), and correlation between trend and mean was \( r = 0.44 \) (\( p < 0.01 \)), whereas mean and variability were correlated with \( r = -0.39 \) (\( p < 0.05 \)). The dendrogram from the results of a Ward’s cluster analysis suggested the presence of distinct clusters in the courses studied. As evidenced by the plots of joining distances, the dynamical parameters form five clusters.

Mean, trend, and variability. Table 1 presents the means of the dynamical parameters of the five clusters. The efficacy and accuracy of the clustering procedure are reflected by the large differences in the means, accounting for up to 84 percent of the variance. The five clusters can be characterized respectively as functioning on a high level (\( n = 7 \)), functioning on a middle level and fluctuating (\( n = 9 \)), showing a middle level accompanied by a slight descent (\( n = 9 \)), showing a steep descent (\( n = 5 \)), and functioning at a low level (\( n = 4 \)). The steep descent cluster was identified in the first step of the hierarchical clustering procedure. To further explore the stability of the clustering procedure, two additional cluster analyses using the centroid and the average-linkage methods respectively (cf. Backhaus et al. 1987) were carried out and compared with the results presented above. In these analyses, the steep descent cluster was identified in full accordance with the results obtained using Ward’s method. Also the low-level cluster was to be found in both additional analyses, with one single case classified otherwise. The three other clusters tended to be summarized as one cluster, the latter result being related to inherent methodological properties differing from Ward’s method (cf. Backhaus et al. 1987).

Significant trends. To complete the description of the clusters, the number of significant trends in each cluster was calculated (table 2). The result is consistent with the picture given by the mean scores of the trends in table 1. Fisher’s exact test evidenced indicative differences among the five clusters. Additionally, from the number of significant downward trends, a difference between the two middle-level groups can be assumed. The trend parameters included in the clustering process contained no information about the significance of these trends. Significance levels were not included in order to retain a largely
The significance of a trend depends not only on the slope, but also on the number of observations and the variability of courses. For instance, in one course, classified in the steep descent subgroup, the trend did not reach significance because of the small number of observations.

### Examples of the Five Clusters

The following case descriptions and the corresponding figures 1 to 5 exemplify the five types of course (names and some personal data have been altered to ensure anonymity). Figures 1 to 5 chart the weekly assessed scores of the NOSIE, as well as the parameters that were used in the clustering procedure: the mean (solid horizontal line), the trend (middle dotted line), and the variability around this trend (upper and lower dotted lines).

#### High-level course.

Peter A. was 26 years old upon entering the program. His problems began at age 19 when he quit his vocational training as an electrician because of conflicts with supervisors and coworkers. The first indications of mental illness were briefly treated in outpatient care, but Peter withdrew from treatment. He wanted to enlist in the army but was rejected on grounds of mental instability. Up to the time of his enrollment in the program, he had worked for no longer than a few weeks consecutively and had ended up living on the streets. At the age of 25 he was diagnosed as having paranoid schizophrenia. He had been feeling increasingly unhappy and resentful of the direction his life was taking. After assaulting a person on the street while in a delusional state, he was compulsorily hospitalized. Following several months of inpatient treatment he was referred to our vocational rehabilitation program. In the assessment phase, he scored very low on the PANSS positive and general symptoms as well as on PANSS negative symptoms. Whereas his insight was limited, his psychological resources in terms of motivation (locus of control and self-concept) and coping (absence of passive coping), as well as his performance in cognitive functioning tests, were favorable. Few problems arose during the course of the program. Coworkers and supervisors liked Peter A. for his candor, levelheadedness, and sense of humor. He actively participated in individual interviews and social skills training groups and developed a new vocational perspective while at the same time learning occupational skills. His behavior as reflected by the NOSIE scores (figure 1) was relatively stable (RMSE = 5.58) and corresponded to a high level of functioning (mean = 240.2). A significant upward trend (slope $\beta = 0.29, p < 0.01$) over the entire period was recorded. Peter A. did well in his training job and succeeded in securing a new apprenticeship as a carpenter.

#### Middle level of functioning/fluctuating.

Marianne B., age 27, was diagnosed as having paranoid schizophrenia at the age of 17 and had been hospitalized five times.

### Table 1. Differences in the Clustering Variables: Mean, Trend, and Variability of the Global NOSIE Score

<table>
<thead>
<tr>
<th>Cluster</th>
<th>Mean (SD)</th>
<th>NOSIE Trend</th>
<th>NOSIE Variability</th>
<th>NOSIE Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Level</td>
<td>237.2 (2.6)</td>
<td>0.10 (0.34)</td>
<td>6.86 (1.55)</td>
<td>237.2</td>
</tr>
<tr>
<td>Middle Level/Fluctuating</td>
<td>226.8 (4.5)</td>
<td>0.08 (0.39)</td>
<td>10.01 (1.79)</td>
<td>226.8</td>
</tr>
<tr>
<td>Slight Descent</td>
<td>224.1 (3.3)</td>
<td>-0.37 (0.46)</td>
<td>6.40 (1.40)</td>
<td>224.1</td>
</tr>
<tr>
<td>Steep Descent</td>
<td>219.3 (4.6)</td>
<td>-2.2 (0.20)</td>
<td>9.47 (2.08)</td>
<td>219.3</td>
</tr>
<tr>
<td>Low Level</td>
<td>213.0 (4.4)</td>
<td>-0.16 (0.37)</td>
<td>12.12 (3.00)</td>
<td>213.0</td>
</tr>
</tbody>
</table>

Note: NOSIE = Nurses' Observation Scale for Inpatient Evaluation; SD = standard deviation.

1. Multivariate analysis of variance ($F = 39.6, df = 4, 25, p < 0.001$); results of univariate tests are given in the table.

2. Post hoc Tukey's honestly significant difference tests ($\alpha < 0.05$).
Middle range. In individual and group settings it was difficult to explore and address his personal problems and goals. His appearance was quite conventional, he rarely spoke, and he seemed rigidly self-controlled and inclined to withdraw. Engaging his family in the rehabilitation program failed, partly owing to a broken home situation and also because Patrick C. did not want there to be any contact between staff members and his family. Whereas the mean NOSIE scores ranged on a middle level (mean = 225.4, figure 3) with no evidence of excessive variability (RMSE = 7.67), the whole course showed a slight but nonetheless significant downward trend (β = -0.28, p < 0.05). At the end of the program, the vocational outcome was unfavorable. Although he performed his work in the vocational unit satisfactorily, he soon dropped out of the program after having been placed in a training job. Patrick C. did not show up for work, and although there were no indications of positive symptoms at that point, it proved impossible to resolve the crisis. A few months later, he was hospitalized in a severe psychotic state.

Steep descent. Daniel D., age 28, had been suffering from a schizoaffective disorder since the age of 20. He had not completed his professional training as a mechanic. At intake both positive and general symptoms were somewhat higher than in most other patients in this study. While the premorbid level of intelligence seemed to be favorable, actual cognitive measures pointed to deficits in both attention and memory. In addition, he reported a high level of externality on the Locus of Control Questionnaire. In the Coping With Stress Questionnaire, a pronounced tendency to use passive-resigned coping strategies became obvious. Interestingly, his work performance during the assessment phase, which is often claimed to be the major predictor for outcome, was excellent. Soon after the start of the program, however, he became discouraged when encountering difficulties in his work. He expressed depressive thoughts such as negative expectations about his future. Over several weeks and despite different therapeutic efforts, Daniel D. became increasingly tense and depressed. The overall course (figure 4) showed a steep descent (mean = 215.7, RMSE =

<table>
<thead>
<tr>
<th></th>
<th>(1) High Level (n = 7)</th>
<th>(2) Middle Level/Fluctuating (n = 9)</th>
<th>(3) Middle Level/Slant Descent (n = 9)</th>
<th>(4) Steep Descent (n = 5)</th>
<th>(5) Low Level (n = 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upward trend</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>No trend</td>
<td>3</td>
<td>7</td>
<td>5</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Downward trend</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>0</td>
</tr>
</tbody>
</table>

1 Fisher's exact test (2-tailed); p = 0.044.
8.87, \( \beta = -2.26, p < 0.01 \)), including a significant downward trend over this short period of time. The patient’s withdrawal from the program and subsequent unemployment could not be prevented.

**Low-level functioning.** Markus E. was 24 years old when starting the rehabilitation program. The onset of schizophrenia, paranoid type, had been recorded 2 years previously. In the meantime, his parents had noted dramatic changes in their formerly sociable and active son, who had now become withdrawn and odd in behavior and appearance. He had been in psychiatric outpatient treatment but had never been admitted. Nevertheless, at intake he showed severe negative and considerable general symptoms as measured by the PANSS. Self-concept was negative according to the FSKN, and he reported a frequent use of depressive-resigned coping responses in the Coping With Stress Questionnaire. Cognitive performance was adequate on the basis of the WAIS nonverbal score but clearly unfavorable on both the concentration and visual memory tests. Work performance during the 2-week assessment phase was fair, whereas general social adjustment was poor, contrasting with his generally favorable premorbid adjustment. Markus E. had graduated from a technical college of high standing. In the family sessions his parents displayed considerable anger about their son’s altered behavior and voiced unrealistically high expectations concerning his professional career. Unfortunately, these attitudes could not be influenced by the family sessions. During rehabilitation, his level of functioning, both regarding social behavior and work performance, was generally low (mean NOSIE = 207.0, RMSE = 8.00, figure 5). Slowness, withdrawal, and inappropriate affect were prominent. While this behavior hindered progress in obtaining a job, a slight but significant upward trend over the whole course was nevertheless recorded (\( \beta = 0.25, p < 0.05 \)). At the end of the training phase, Markus E. was referred to a sheltered workshop where (without being excessively pressured) he eventually made further progress.

**Comparing the Clusters: Clinical Measurements and Outcome.** After identifying the five clusters, we examined them with regard to both clinical measurements at intake and rehabilitation outcome. In table 3, the clinical measurements are depicted by cluster. Because the variables in the areas of (1) psychopathology, (2) cognitive functioning, and (3) personality and coping are conceptually related, multivariate analyses of variance were calculated first. Subsequent univariate analyses and post hoc comparisons are given to further explore the differences among the clusters. While the number of patients is relatively small for this type of analysis, the results showed large effect sizes, reflecting clinically significant differences among the clusters.

**Clinical measurements.** The high-level subgroup exhibited positive characteristics in nearly all the variables. This subgroup’s low incidence of negative and general symptoms on the PANSS was especially striking. This subgroup also demonstrated the best performance in most of the cognitive assessments. The middle-level/fluctuating subgroup displayed moderate scores on many variables. It also had the highest score of all the groups in the overall performance of the d2 concentration test. The middle-level/slight descent subgroup overall was similar to the former group. On some items, this subgroup tended to achieve somewhat more favorable results than the middle-level/fluctuating subgroup, and it showed the most positive self-concept scores. The steep descent subgroup, patients displaying a rapid and precipitous decrease in their functioning, suffered from a higher incidence of psychopathology than the previously mentioned subgroups. This subgroup showed a negative self-concept and an extremely high level of fatalism on the Locus of Control Questionnaire. Finally, the low-level functioning subgroup was the most disturbed with regard to psychopathology. Differences pertaining to both negative symptoms and general psychopathology were evident in comparison with the other subgroups. This last subgroup was the most impaired on the Visual Retention Test and the d2 concentration task. As in the previous subgroup, this subgroup’s self-concept was very negative.

**Outcome.** Table 4 illustrates the outcome of the rehabilitation process for each cluster. The types of outcome were dichotomized into favorable and unfavorable: a favorable outcome consisted of successful job placement in competitive jobs or lasting job tenure, whereas an unfavorable outcome was defined by the lack of such achievement. The overall difference in frequencies was highly significant using Fisher’s exact test. The high-level subgroup exhibited favorable outcomes. In the two subgroups steep descent and low-level, none of the patients achieved a favorable outcome. The middle-level/slight descent subgroup performed somewhat better, but was clearly inferior compared with the high-level subgroup, whereas the middle-level/fluctuating subgroup demonstrated a level of success that seemed identical to the high-level subgroup.

**Discussion**

The purpose of this study was to explore the dynamics of the psychosocial functioning of persons with schizophrenia who participated in a vocational rehabilitation program. On the basis of weekly behavioral ratings, five dynamical patterns of response to a vocational rehabilitation program could be identified: (1) high-level, (2) middle-level/fluctuating, (3) middle-level/slight descent, (4)
Table 3. Psychopathology, cognitive functioning, and personal resources by cluster

<table>
<thead>
<tr>
<th>Cluster</th>
<th>Psychopathology</th>
<th>Cognitive Functioning</th>
<th>Personality and Coping</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n = 7) Mean (SD)</td>
<td>(n = 9) Mean (SD)</td>
<td>(n = 9) Mean (SD)</td>
</tr>
<tr>
<td><strong>Psychopathology</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PANSS positive symptoms</td>
<td>10.3 (2.3)</td>
<td>12.3 (4.2)</td>
<td>10.6 (3.7)</td>
</tr>
<tr>
<td>PANSS negative symptoms</td>
<td>10.1 (2.7)</td>
<td>14.9 (4.7)</td>
<td>15.7 (7.3)</td>
</tr>
<tr>
<td>PANSS general symptoms</td>
<td>22.4 (4.1)</td>
<td>30.1 (6.8)</td>
<td>28.3 (5.7)</td>
</tr>
<tr>
<td><strong>Cognitive Functioning</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WAIS verbal</td>
<td>98.3 (10.5)</td>
<td>98.0 (7.9)</td>
<td>96.8 (12.9)</td>
</tr>
<tr>
<td>WAIS nonverbal</td>
<td>107.1 (10.3)</td>
<td>99.1 (5.1)</td>
<td>104.2 (11.4)</td>
</tr>
<tr>
<td>Benton total score</td>
<td>8.4 (1.3)</td>
<td>6.3 (1.1)</td>
<td>7.4 (1.7)</td>
</tr>
<tr>
<td>Benton errors</td>
<td>2.1 (2.1)</td>
<td>5.1 (1.7)</td>
<td>3.7 (3.3)</td>
</tr>
<tr>
<td>d2 concentration performance</td>
<td>341 (81)</td>
<td>385 (64)</td>
<td>306 (75)</td>
</tr>
<tr>
<td>d2 concentration percentage errors</td>
<td>4.3 (3.4)</td>
<td>8.7 (3.7)</td>
<td>11.8 (9.5)</td>
</tr>
<tr>
<td><strong>Personality and Coping</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-concept</td>
<td>330 (39)</td>
<td>337 (68)</td>
<td>347 (55)</td>
</tr>
<tr>
<td>External locus of control: fatalism</td>
<td>23.6 (4.0)</td>
<td>24.4 (6.0)</td>
<td>25.2 (5.8)</td>
</tr>
<tr>
<td>Depressive-resigned coping</td>
<td>74.6 (39.1)</td>
<td>73.0 (26.8)</td>
<td>77.9 (22.4)</td>
</tr>
</tbody>
</table>

Note.—MANOVA = multivariate analysis of variance; NS = not significant; PANSS = Positive and Negative Syndrome Scale; SD = standard deviation; WAIS = Wechsler Adult Intelligence Scale.

1 Post hoc Tukey's honestly significant difference tests (p < 0.05).
2 Results of univariate tests (df 4,29) are given in the table.
3 MANOVA (F = 7.40, df = 4,29, p = 0.0003).
4 MANOVA (F = 6.10, df = 6,27, p = 0.0004).
5 MANOVA (F = 4.70, df = 4,29, p = 0.0048).
Table 4. The outcome of vocational reintegration by cluster

<table>
<thead>
<tr>
<th></th>
<th>(1) High Level</th>
<th>(2) Middle Level/Fluctuating</th>
<th>(3) Middle Level/ Slight Descent</th>
<th>(4) Steep Descent</th>
<th>(5) Low Level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n = 7)</td>
<td>(n = 9)</td>
<td>(n = 9)</td>
<td>(n = 5)</td>
<td>(n = 4)</td>
</tr>
<tr>
<td>Unfavorable (no job placement after training)</td>
<td>1</td>
<td>2</td>
<td>7</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Favorable (job placement or job tenure)</td>
<td>6 (4)²</td>
<td>7 (5)</td>
<td>2 (2)</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

¹ Fisher's exact test (2-tailed): p = 0.0007.
² Numbers in parentheses after other numbers in the table indicate the number of subjects with job tenure for at least 6 months.

steep descent, and (5) low-level functioning. The subgroups of patients showing these patterns strongly differed in the mean, the trend, and the random fluctuations of the behavioral ratings.

At intake, these subgroups varied in psychopathology and cognitive dysfunction and in measures of self-concept, locus of control, and coping. At the end of the program, pronounced differences were found among the subgroups regarding vocational reintegration. The five different course patterns of psychosocial functioning can be understood as typical pathways, linking patient characteristics to the outcome of rehabilitation.

Patients from the high-level functioning subgroup presented at intake the least amount of symptoms on all subscales of the PANSS, fair to excellent results in two tests of concentration and visual memory, and favorable scores on the measures of personality and coping. Half of these patients showed a significant upward trend over the whole course of the vocational rehabilitation program. The outcome of rehabilitation was favorable for all but one patient of this subgroup.

The two middle-level subgroups deviated from the simple rule of prediction that poor performance at intake means unfavorable outcome. The middle-level/fluctuating subgroup showed an outcome comparable to the high-level functioning subgroup, which was clearly better than the outcome of the middle-level/slight descent subgroup. This is surprising, as one would expect pronounced fluctuations in the level of functioning to be unfavorable for vocational reintegration. The middle-level/slight descent subgroup scored moderately in psychopathology and cognitive functioning and showed the most positive self-concept of all groups. The outcome data for this subgroup point to the possible importance of slight but significant trends as indicators of an unfavorable course. The differences between these two subgroups might be related to specific personality factors and coping strategies (cf. Mueser et al. 1997). Interactive processes, including the avoidance of relevant stimuli driven by negative emotional states as suggested by Brenner (1989), might account for the rather unfavorable outcome in the middle-level/slight descent subgroup. Valuable insight into the disparities between the two middle-level subgroups could be gained by further research.

The pattern of steep descent leading to an early dropout from the program is a substantial finding in this study. At intake, this subgroup exhibited, among other difficulties, both a substantial level of symptoms and deficits in the visual Retention Test. Specifically, the patients showing a pattern of steep descent started with favorable behavioral ratings in the first weeks of rehabilitation. The steep descent in functioning might be due to the severity of the disorder but may also have been intensified by strong fatalistic beliefs, as this subgroup scored most unfavorably on the Locus of Control Questionnaire and reported the highest frequency of passive-resigned coping responses. Nevertheless, psychopathology and cognitive deficits were somewhat milder in the steep descent subgroup than in the low-level functioning subgroup, in which the low level of functioning during rehabilitation was paralleled by unfavorable ratings on most of the measures at intake.

While the influence of psychopathology, cognitive deficits, and personal resources (i.e., locus of control) on the dynamics and outcome of vocational rehabilitation might seem obvious, many of these factors are not accurately discussed in the literature on the rehabilitation of the chronically mentally ill. The impact of psychopathology and cognitive functioning on vocational functioning and the outcome of vocational rehabilitation has been seriously underestimated in older, methodologically inadequate studies (cf. Anthony and Jansen 1984). Our findings are in line with more recent studies that have found relationships between psychopathology—especially nega-
tive symptoms—and vocational functioning (Massel et al. 1990; Glynn et al. 1992; Anthony et al. 1995; Lysaker and Bell 1995). Cognitive deficits, on the other hand, have been found to be related to a change in symptoms during vocational rehabilitation of schizophrenia patients (Lysaker et al. 1995). In our study there was no significant difference in the global level of cognitive performance as measured by the WAIS, but the subgroups differed on the d2 concentration test and more strongly on the Benton Visual Retention Test. The differentiating power of the cognitive measures used might stem from the fact that both the Benton Visual Retention Test and the d2 concentration test uncover deficits that are related to negative symptoms (Strauss 1993).

Any approach that postulates patterns as being typical should also specify the less probable patterns. Our findings suggest that the mean level of functioning and the amount of variability or random fluctuation, complemented by linear trends, represent a reliable and valid description of the response to psychosocial intervention in schizophrenia patients for a time frame of 2–18 months. Processes of change in overall social and vocational functioning were rather slow and were observable as linear trends in the course of individual patients. The use of linear regression models in this study to examine trends precluded the quantitative examination of nonlinear trends. Given larger samples, it would be possible to test whether additional nonlinear components or sudden change models would significantly improve the description. However, the good fit of the models used in this study, the strong and meaningful differences between the subgroups—explaining a great proportion of variance—as well as visual inspection of the courses do not suggest nonlinear trends or sudden changes as a common and discriminating pattern.

Should the importance of linear trends be confirmed in further studies, then the patterns proposed by Strauss et al. (1985) would not apply to psychosocial rehabilitation, at least not to the kind of settings and measures analyzed in this study. For example, the crisislike pattern of a “low turning point” (Strauss 1989) was not widespread in our results as an overall pattern. Likewise, the pattern termed “woodshedding” (Strauss 1989) might not be typical for goal-oriented and demanding rehabilitation programs. Woodshedding involves phases of rest and withdrawal accompanied by subtle changes and learning. However, this pattern would be at variance with a rehabilitation program, as noncompliance with the demands of the program could easily promote negative psychosocial interactions between patients and professionals, possibly resulting in escalating feedback loops. Such hindering interactions could also result when the acquisition of new skills and psychological resources occurs too slowly to compensate for reactions to the prolonged and increasing stress that is imposed by goal-oriented rehabilitation. We formalized these hypotheses in a dynamical mathematical model that can be specified by relevant parameters when more supporting data are available (Kupper and Hoffmann 1995).

Extending the hypotheses of Strauss et al., a pattern of “sudden relapse” was not found in this study, although two patients with affective bipolar disorder attending our rehabilitation program did show such a course. Further research might substantiate that the patterns proposed by Strauss apply more to developments on a large time scale (i.e., years), that they often include major changes in different domains of psychosocial functioning (e.g., loss of job, new personal relationships, release from hospital), and that they reflect a more personal overall description of the dynamics. This might be related to the way these hypotheses were generated, using intensive qualitative interviews. Conversely, the approach presented in this article and its results are more specific and quantitative. The patterns found in this study may be valid mainly for chronic, relatively stabilized schizophrenia patients attending demanding rehabilitation programs. The extent to which these patterns can be generalized to other rehabilitation approaches remains open to conjecture. Nor has any information been generated by the present study in regard to how the patterns of functioning found during rehabilitation are related to the long-term course of the disorder.

The patterns apply to overall changes in behavior that are relevant for the goals of rehabilitation, as measured in weekly observations. Analyzing the dynamics of schizophrenia with other variables, methods of measurement, time scales, and groups of patients can complement the results presented here. For instance, Tscherch et al. (1997) investigated daily ratings of symptoms of patients with acute schizophrenia; they found indications for nonlinear and possibly chaotic dynamics in a considerable subgroup.

Clearly, the number of patients in our study is small, and the stability of the patterns and clusters has to be confirmed by further research. Moreover, the breadth of the observation period (14 to 88 weeks) raises questions regarding the stability of the estimates, especially for the courses with fewer observations. The wide variation in the observation period is ascribable to the study’s focus on functioning within a vocational rehabilitation program, where termination or dropping out is possible at any point. Fewer observations were typical for the steep descent and low-level functioning subgroups. However, the clear differences in course among the subgroups, as evidenced by cluster analysis, cannot easily be explained by a shorter observation time. Unreliability in the estimates of mean, trend, and variability would tend to “blur” the results. Issues of observation time should nonetheless
be considered, especially in situations where the course might frequently include turning points. Wider ranging studies using various treatment modalities on different groups of patients will be crucial for advancing knowledge in the field. In this study, an overall behavioral measure of functioning was used. This approach was instrumental in answering the question as to whether there were any observable and meaningful dynamical patterns of response to psychosocial rehabilitation and for examining the inherent importance of a general indicator of functioning during rehabilitation. For further studies, the inclusion of personal vulnerability factors and related variables might be of great importance. Introducing additional variables and instruments, including repeated psychophysiological and cognitive measurements, could be pivotal in clarifying the processes of change (Brenner 1989; Tarrier 1989; Tarrier and Turpin 1992). First studies analyzing both behavioral and cognitive variables during the rehabilitation of inpatients are available (Spaulding et al. 1999), but this combined approach has not yet been extended to the comprehensive rehabilitation of schizophrenia outpatients.

Particularly because patterns of response will depend on the characteristics of patients and programs, specific knowledge is needed about the modus operandi of psychosocial intervention programs. The specific impact and time course in relation to patients’ characteristics are crucial for the use and further development of these interventions (Bellack and Mueser 1993). For instance, it seems both necessary and feasible for clinicians and rehabilitation professionals to gain a greater insight into the dynamics in a vocational rehabilitation program in conjunction with the characteristics of the individual patient. Since the instruments used in this study are well known and easily accessible and the measurements can be performed within a reasonable amount of time, such assessments could become routine in rehabilitation. Anticipating patients’ potential reactions to the program and the ensuing dynamical patterns might help to prepare them for the stress they will face, aid in counterbalancing dysfunctional emotional reactions, and possibly guide them to adopt more appropriate coping strategies. This knowledge could also lead to a more specific and timely use of social skills training (Liberman et al. 1990) and other interventions. Furthermore, the monitoring of trends could form a rational basis for early intervention; in particular, patients showing negative symptoms at the start of the program, high levels of cognitive deficits, or strong fatalism should be closely followed. In these instances, additional intervention and a reduction of the demands placed on the patient may be advisable.

In our view, a wider implementation of dynamical designs could substantially clarify varying patient reactions to psychosocial intervention. Hypothetically, the five patterns identified in this study depict characteristic responses of subgroups of schizophrenia patients to psychosocial rehabilitation programs. Combining the approaches presented here with repeated assessment of cognitive and psychophysiological variables could enhance the theoretical understanding of the dynamics in rehabilitation and help to refine intervention. In general, approaches that include dynamical perspectives both as part of the theoretical background and in empirical research are a promising line of investigation for schizophrenia research in the future.

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**Acknowledgments**

This research was supported in part by the Swiss National Science Foundation, Grant 3200–028795. The authors wish to express their gratitude to Hans D. Brenner, M.D., Ph.D., and Hugh Freeman, M.D., as well as to the reviewers for their valuable comments on earlier versions of this work. We would like to thank Barbara Zach-Miller for her help in correcting and editing the manuscript.

**The Authors**

Zeno Kupper, Ph.D., is Research and Clinical Psychologist and Lecturer, and Holger Hoffmann, M.D., is Senior Lecturer and Associate Medical Director, University Psychiatric Services Bern, Department of Social and Community Psychiatry, University of Bern, Switzerland.