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Coping with Attentional Disorders as a Systemic Process in Schizophrenic Patients

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Around the turn of the last century, Kraepelin and Bleuler developed the theory that some schizophrenic symptoms can be traced back to attentional disorders and in contemporary experimental research on attention, this reappears in the thesis that attentional disorders cause a vulnerability to schizophrenia. Empirical studies (Nuechterlein & Dawson, 1984) showed that attentional deficits before, during, and after an episode of such illness are consistent with the vulnerability model. However, if attentional disorders really do play a fundamental role in the development of schizophrenic symptoms, how do patients handle their more-or-less intact attentional capabilities? Thus, at the current level of research, the relevant question is not only whether attentional disorders occur, but – more and more – how such patients process information in the presence of these disorders.

Studies which focus on a highly specialised part of a phenomenon, though, are unlikely to contribute very much to the conception of new therapies: rather their development requires a relatively general, multidimensional perspective. In the present case, this means that in addition to the evaluation of attentional performances and possible deficits, it is also necessary to analyse how schizophrenic patients rate their own accomplishments subjectively, how strongly they are physiologically activated during attentive phases, how they experience their activation, and which overt behaviours they assume to change external conditions. For these purposes, five levels of analysis have been used:

1. *Of objective attention performance.* This results from two classical attention tests – reaction time and continuous performance.

2. *Of subjective performance.* The attentional performance is rated on a scale by the patients themselves. Perception and judgment of performance are doubtless determining factors in the pattern and efficiency of coping efforts, and thus can themselves be considered part of the coping behaviour.

3. *Of psychophysiological activation.* Since the processing of attention disorders is a problem of coping with stress, and since psychophysiological measurements provide an important access to that phenomenon, we have also registered the act of processing on the psychophysiological level. The assessments concentrated on four parameters, which indicate the activation of the automatic nervous system: skin conductance reactions, skin conductance level, heart rate, and respiration rate. But since we were interested not only in the states of activation and changes of activation during the tests, but also wanted to see how schizophrenic patients prepare physiologically for such tests, we continued to measure activation during a state of relaxation, and compared the data.

4. *Of subjective activation.* This was understood to include tension, strain, and effort, which the subjects experienced from their point of view during the attention tests, and which they also rated on a scale, together with the subjective performance. The level of subjective activation and the psychophysiological states were regarded as indicators of stress.

5. *Choice between two behaviours.* This was understood to mean manifest behavioural patterns with which the subject tried to change outer conditions. The experiment was set up in such a way that the subjects themselves could have a limited influence in the situational setting: they had a choice of two versions in both attentional tests – a simple one and a more complex one. After gaining some experience with these versions, they had to decide with which one they would like to finish the tests, and so it was therefore up to them to set the degree of complexity of the stimulus field.

The experimental design aimed to answer the following questions: To what extent are schizophrenic patients, in comparison with normal people, able to regulate the psychophysiological level of activation to meet situational requirements? How differentiated are the objective performance and autonomic arousal represented in patients' subjective experience? How far do schizophrenic patients integrate their subjective performance and level of activation into the process of decision-making between two stimulus conditions of different complexity?

In order to reduce the variability of results as far as possible, the schizophrenic sample was divided into electrodermal responders and non-responders

respectively. On the assumption that physiological reactivity plays a part in overcoming stress, and since responding and non-responding are related to protective mechanisms against stressors (Straube, 1979; Dawson & Nuechterlein, 1984), this division seemed useful and appropriate.

Method

Twenty-four voluntary, mainly chronic in-patients, with an average age of 29.9 years, took part in the study. They were diagnosed as schizophrenic by the Present State Examination (Wing *et al*, 1974) and according to DSM-III criteria on the basis of medical records. The sample was divided into 12 electrodermal responders and 12 non-responders, according to the results of tests with acoustic stimuli. However, the orienting reactions of a total of 30 patients had to be registered, before these numbers were obtained. The groups were matched for age, education, and duration of hospital stay. There were no statistically significant differences between the groups regarding these variables, medication (in chlorpromazine equivalents), or seriousness of illness, as assessed by the overall score in the Brief Psychiatric Rating Scale (Overall & Gorham, 1962). Both schizophrenic groups were compared with 24 normals, matched in age and education. Among the controls, there were 22 responders and two non-responders.

The two versions of the reaction time test were constructed as follows: the simple one consisted of 20 tones in constant, 3.5 s intervals, and the complex one consisted of 20 acoustical and optical signals in a randomly changing order. In this latter version, stimuli appeared in irregular intervals with an average length of 3.5 s. The versions of the continuous performance test included 21 tachistoscopic projections of numbers, in which critical numbers were placed at random: in the simple version, three numbers per projection had to be recognized, while in the complex version there were six. After each block of trials, the

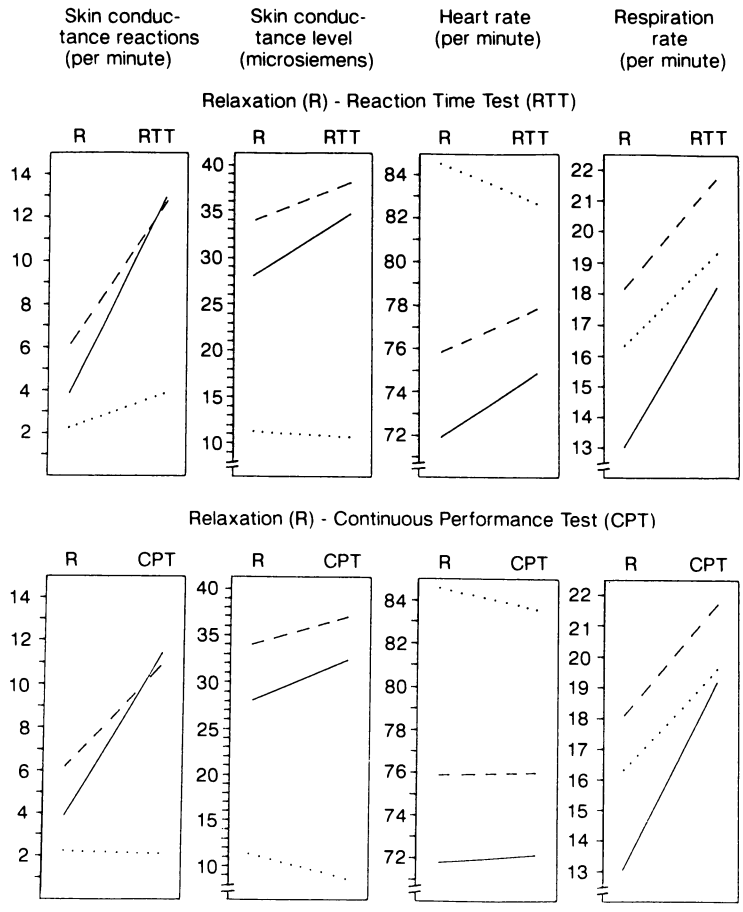

FIG. 1 Psychophysiological activation in relaxation and two attentional tests (- - - - schizophrenic responders; ····· schizophrenic non-responders; ——— normal control group).

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subjects rated their performance on a ten-point scale ('subjective performance'). They also rated the tension, strain, and effort experienced during the tests ('subjective activation').

The experimental session, in which the responsible psychologist was blind to the previously gathered clinical information, took place as follows: Assessment of the electrodermal orienting reaction, two minutes of relaxation, reaction time test, two minutes of relaxation, continuous performance test, and again two minutes of relaxation. In the evaluation, the results were averaged across the three phases of relaxation. The attentional tests were divided into five subperiods: Simple version, complex version, repetition of the simple and of the complex version, and free choice of one of the versions by the subject.

Under all experimental conditions, four psychophysiological parameters were measured: skin conductance reactions and skin conductance level through electrodes at the non-dominant hand, the heart rate with a photoelectric device attached to a finger, and the respiration rate by a respiratory belt placed around the abdomen.

Results

Psychophysiological activation during relaxation and during the attentional tests

Figure 1 illustrates changes in psychophysiological activation between relaxation and states of attention. The findings about changes of the activation between relaxation and attention allow the following general statement: The controls showed the strongest rise in activation, schizophrenic responders a medium rise, and schizophrenic non-responders the weakest rise. An analysis of variance demonstrated that the degree of change in activation among the three groups differed significantly in seven of the eight cases at least at the 5% level. A *post-hoc* comparison of means according to Scheffé showed that the patients modulated their activation less distinctly between relaxation and performance than did the controls. Moreover, the modulations of the non-responders were characterised by the peculiarity of a falling, rather than a rising activation level between relaxation and attentional tests, with regard to heart rate and skin conductance level.

It was remarkable that the degree and direction of the physiological modulation were not only a function of the initial values: for instance, the non-responders always had a smaller increase in activation than the other two groups, although their initial values differed in terms of the psychophysiological parameters.

The various measurements of activation during relaxation, reaction time test, and continuous performance test did not allow the single groups to be generally defined as hyper- or hypo-aroused, which can be clearly seen in the example of the non-responders. On the one hand, their electrodermal activation, expressed in skin conductance level and number of skin conductance reactions, was significantly lower than that of the controls and of the responding patients. On the other hand, in terms of heart rate, non-responders were hyper-aroused in comparison with controls. The responders' autonomic nervous system was hyper-aroused under most conditions, as compared to normal states, but this was considerable only in the case of the respiration rate during relaxation. The data of the three groups suggest the conclusion that the schizophrenic responders tend to be hyper-aroused compared to the controls, whereas the non-responders exhibited a dissociation of the autonomic subsystems, in the sense of electrodermal hypoarousal with simultaneous cardial hyperarousal.

Differentiation between the test versions on various levels

Figure 2 contains the results of both attentional tests for the three samples. Both tests were carried out on four different levels, in the simple and complex versions: the results of the objective performances are indicated in the two diagrams on the far left. As foreseen, all three groups scored lower in the complex version than in the simple one, which is expressed by the descending straight lines. The performances dropped significantly between the simple and complex version in all groups and in both attentional tests, according to one-tailed t-tests (at least $P<0.01$).

The subjective performances essentially reflect the objective facts correctly in all groups, since here too, the curves illustrate a subjective decrease in performance from the simple task to the complex one. Comparisons of the means with t-tests reveal significances (at least $P<0.01$), except with respect to the reaction time test in the groups of patients. There is reason to believe that the non-significant results are type II errors: In an unpublished pilot study with ten schizophrenic patients and ten students, in which the subjects were made to guess their reaction time after each trial, correlations between objective and subjective data were about as high with patients as with normals. These findings imply that schizophrenic patients are similarly aware of their personal performance as normals in both attentional tests.

The diagrams indicating psychophysiological activation represent an attempt to integrate the four physiological parameters into one overall score. To this end, the results for each parameter were standardised and then added together. The curves based on the overall score show slight increases of activation, or at least no decreases, from simple to complex versions in all the groups, but almost no changes of significance. These data can therefore not be taken to prove different reactions of the vegetative nervous system to the changes in conditions within the attentional tests.

All the curves representing subjective activation rise from the simple to the complex version, and the differences proved to be significant (t-tests, at least $P<0.05$), except in the reaction time test with the responders. According to this, different statements about the activation experienced correspond to the different levels of complexity of the stimulus field.

Thus, all three groups reacted in a differentiating way to the more or less demanding stimuli: for the most part, they noticed differences in personal performance and felt more activated in complex conditions. Analysis of variance did not indicate any group-specific superiorities in the differentiations of subjective judgments at any level.

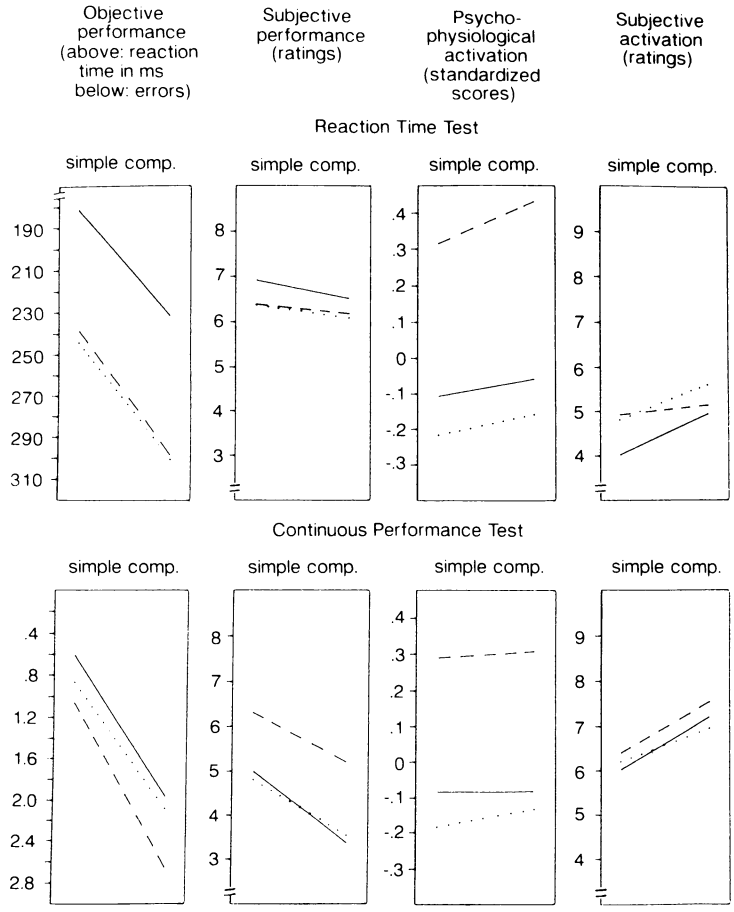

FIG. 2 Differentiations between simple and complex versions of two attentional tests on several levels (- - - - schizophrenic responders; ····· schizophrenic non-responders; ——— normal control group).

Choice of versions

In order to obtain larger samples, both schizophrenic groups were aggregated, before comparing the choices of the versions. Both patients and controls chose the simple version more often in the continuous performance test than in the reaction time test (patients: 61% *v.* 38%; controls: 54% *v.* 33%). The differences between the tests were significant, according to binomial tests in both samples (both $P<0.05$). However, both patients and controls rated their performances significantly lower in the continuous performance test than in the reaction time test, according to *t*-tests (patients: $P<0.05$; controls: $P<0.001$; two-tailed), and at the same time expressed a higher level of subjective activation (patients: $P<0.01$; controls: $P<0.001$; two-tailed). Therefore, both groups reacted to the subjective loss in performance and rise of activation, caused by the continuous performance test, by preferring a relatively easy version of it. The version preferred helped to minimise the subjective loss of performance and rise of activation – the simple versions having led to subjectively good performances and low levels of activation (see Fig. 2).

Discussion

The psychophysiological values demonstrated that the predominantly chronically schizophrenic patients, and among those primarily the patients without electrodermal orienting reactions, had problems with their physiological modulation: they were capable of only slight variations of psychophysiological activation in dependence on more or less demanding conditions (relaxation/attentional tests). If attentional behaviour is presumed to require a systematic allocation of processing capacity, and vegetative arousal to be a correlate of this capacity (Kahneman, 1973), it seems reasonable to associate weaknesses

in schizophrenic modulation with the attentional performance deficits observed. It is basically more adequate to relate attentional performance to physiological modulation and therefore to differential values than to general physiological states, expressed in absolute terms like hypo- or hyper-activation. Since levels of activation may differ within one subject, and can be above or below normal, depending on the parameters chosen, a general statement seems problematic. Our physiological measurements during phases of relaxation and performance respectively showed that scores can be reduced or increased, depending on the schizophrenic subgroup and dimension observed. Such results confirm multidimensional concepts of arousal (Dawson & Nuechterlein, 1984).

Weaknesses in physiological modulation probably also relate to symptoms, particularly to negative symptoms, and clinically, may indicate low motivation. Such an interpretation fits with the findings of Straube (1979), who found that electrodermal non-responders, who in our investigation showed little modulation in their arousal, are characterised by emotional withdrawal and flattening.

In the context of our topic of coping with problems or stress, the physiological peculiarities mentioned above are more relevant as situation-bound concomitants of psychological coping processes during the experiment than as a requirement for attentional performance or expression of a habitual state of motivation. Thus, the degree of psychophysiological modulation can also depend on the evaluation of the situation. Weak modulation, as it appeared in connection with the patients, can therefore indicate either that they felt only slightly challenged by the tests, or that they may have been overstimulated and tried to avoid stronger vegetative changes. According to the second interpretation, reduced modulation has a protective function in relation to stimulations experienced as aversive; similarly, Straube (1980) and Johnson (1985) have interpreted diminished physiological reactivity of schizophrenic patients as a defence mechanism against overstimulation.

The ambiguity of the physiological findings described reflects, on the one hand, that physiological states can (rightly) be interpreted from several aspects, and on the other, that some basic problems of psychophysiological research have not yet been solved. In the case of schizophrenia, it is still unclear whether the physiological events are the cause of the performance deficits often observed (the question of causality), and what mental realities are connected with them, in what way (the problem of the psychophysical covariation). The question remains open whether vegetative activation relates to the control of attention, or rather to affective appraisals (cognitive versus emotional interpretation; Öhman, 1981).

Regarding the perceptions of differently complex stimulus configurations at various levels, results concerning the rating of the individual performances and of the state of activation indicated that the judgments of both patients and controls were generally realistic enough to guarantee a sensible control of behaviour. In contrast, no definite differentiations depending on the complexity of the stimulus configurations could be derived from the psychophysiological variables, so that the psychophysiological states were not a reliable basis for the subjects to inform themselves about the degree of complexity that was adequate for their possibilities. Thus, the subjects reacted to changing stimulus constellations more sensitively on the subjective than on the psychophysiological level.

In both the reaction time and continuous performance tests, the subjects had the opportunity of choosing the degree of complexity of the stimuli by deciding between a relatively simple and a relatively complex version. Both patients and controls estimated their performance in the continuous performance test as relatively low and the activation as relatively high, and chose the simple version more often. In the simple versions, the subjective performances were regularly better, and the levels of subjective activation lower than in the complex versions. This means that the subjects set the standards of the continuous performance test, which was to be solved after the reaction time test, in such a way that they were able to approximate to the level of subjective performance and activation that they had usually reached in the reaction time test. In this interpretation, the choices of both patients and controls are compensatory operations with the goal of making up for the subjective changes caused by the new stimulus constellations. Such an interpretation implies that the samples examined were orientated towards a constant nominal value in terms of subjective performance and activation, and that the choices had a homeostatic function.

In terms of systems theory, the schizophrenic patients reacted to the degree of complexity of the tests basically in the same way as the controls, viz – in the sense of a negative feedback with which they started a homeostatic control loop. In so far as control loops belong to the basic systemic models, it can be said that person and environment were systemically connected in our experiment.

This study also has implications with regard to therapy: on the psychophysiological level, the considerable inter-individual differences in activation

show that interventions aimed at psychophysiological changes should be adjusted individually. It should not be the general objective to obtain low arousal; depending on the patient, some autonomic systems can also be under-aroused. Therefore, it is advisable to plan interventions which are specific to the patient and restricted to single parameters: how far biofeedback permits such selective interventions still has to be proved.

The relatively narrow range of psychophysiological modulation in schizophrenics, especially non-responders, also makes changes in therapy desirable, though appropriate arrangements still have to be developed. If psychophysiological modulation depends on ratings of one's own performance and of situative challenges, it is conceivable that it can be influenced by cognitive restructuring.

Although, according to our measurements, schizophrenic patients do not seem to experience their activation essentially in a less differentiated way than normal controls, more sensitive experiences on the part of the patients could be helpful: Overstimulation, as it is often reported by schizophrenics, requires a more distinctive perception of their own condition and of its dependence on outer circumstances, so that they are able to control their behaviour according to the specific demands. To render effective the self-stabilising tendencies which aim at homeostasis (Böker & Brenner, 1983), rich and conscious perceptions of the subjective state of mind are necessary.

Whether attentional performances can be increased through interventions at the psychophysiological level, through emotional activation and cognitive restructuring, is a question to be answered in studies of interventions. However, it seems appropriate to place in a more general context our present efforts to improve the attentional performance of schizophrenic patients by a therapy programme, which involves the integrative training of cognitive, communicative, and social skills (Roder *et al*, 1988). Only a systemic approach which includes several levels simultaneously can do justice to the complexity of illness processes, and thus be of potential therapeutic relevance.

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