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ELECTRODERMAL INDICATIONS OF LEVELS OF PSYCHOLOGICAL DISTURBANCE IN CHRONIC SCHIZOPHRENIA

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CHAPTER I

INTRODUCTION

Of all the mental disorders of man, schizophrenia has been the most actively investigated (Bellak, 1958). This interest has been well justified in view of the magnitude of the problem. The basic prevalence of schizophrenia has been estimated to be 250 per 100,000 in the United States and western nations. Not only is the basic incidence impressive, but the tendency toward chronicity further magnifies the importance of the problem. The average length of hospitalization in the United States for schizophrenia is cited as 13.1 years. Chronicity is responsible for the fact that approximately 47 per cent of the beds in mental hospitals are occupied by schizophrenic patients, whereas the same patients account for only about 25 per cent of the admissions (Lemkau & Crocetti, 1958). In addition to the misery

suffered by the victims and their families, it is obvious that chronic schizophrenia is a serious social and economic problem.

Despite the great interest in schizophrenia, most of the literature has been devoted to the period of onset and the early stages while the investigation of later and well established stages has been relatively neglected (Arieti, 1955). The problem of chronic schizophrenia, particularly levels of psychological disturbance, is the focus of this investigation.

Chronic Schizophrenia

Problem of definition. Not the least of the many problems in the investigation of "chronic" schizophrenia is that of definition. Although the terms "acute" and "chronic" are commonly used, there are no clear criteria for such a distinction. The criterion problem leads to some confusion as was verbalized by a participant at one of the conferences on the effects of "tranquilizer" drugs, who said:

> We find that these investigators used no standards for acuteness and for chronicity. To Goldman, acute was up to five years, and in his present paper he has extended this to ten years; to Kinross-Wright acute means less than six months and subacute, less than two years; to Lehman acute implies less than one month's duration; and to Loman it is defined as less than two

> years' hospitalization. The results are naturally quite variable. There is a range in the acute case from 24 per cent to 87 per cent for complete recovery or social remission, and one from 2.3 to 56 per cent for the chronic (Bennett, 1955, p. 47).

The current Diagnostic and Statistical Manual of Mental Disorders uses the term "chronic" in conjunction with schizophrenia in only one major classification: Schizophrenic Reaction, chronic undifferentiated type. This, no doubt, serves as a "waste basket" category in which no effort was made to specify the meaning of the term "chronic." On the other hand, Chronic Brain Syndrome is somewhat more explicitly defined as resulting from a "relatively permanent, more or less irreversible, diffuse impairment of cerebral tissue function" (American Psychiatric Association, 1952, p. 18). In chronic schizophrenia, the lack of such an explicit statement, i.e., "relatively permanent, more or less irreversible" is probably the result of an unwillingness to acknowledge the relative permanency of the condition when the cause is in doubt.

Despite the criterion problem and the lack of definition in the diagnostic manual, it has been the experience of hospital staffs everywhere that the condition of many schizophrenic subjects is "relatively permanent and more or less irreversible," i.e., chronic. Despite treatment efforts,

including the use of tranquilizing drugs, only minor or temporary effects are seen (Clark, Ray, Paredes, Costiloe, Chappell, Hagans, & Wolf, 1961) and the "back wards" continue to be an unpleasant reality.

Descriptions of chronic schizophrenia. Since the early descriptive writings of Kraepelin (1925) the area of chronicity has been relatively neglected. As Arieti has said of him:

> His monograph, "Dementia Praecox and Paraphrenia," remains until today the most complete description of the symptoms of the schizophrenic from a phenomenological point of view. [But] . . . except for the repeated mention of the fact that the patient decays progressively to reach a state of idiocy, we do not see in the Kraepelinian description different stages or any real movement, even toward regression. The patient is always seen in cross-section (1955, pp. 11-12).

Kraepelin appears to have been more interested in a descriptive view of the thoughts of patients rather than in structure or principles.

During about the same years Eugen Bleuler (1857-1933) made an attempt to go beyond the merely descriptive approach by incorporating some of the thinking of Freud. He advanced the concepts of "autism" and "schizophrenic negativism." According to Arieti:

> As far as negativism is concerned, Bleuler thought that it could not be explained solely as a motor

> phenomenon. He was inclined to consider it as a psychological attitude (1955, p. 18).

The issue of motor deficit vs. mental set has also been considered in the experimental literature which will be discussed in a later section.

Arieti described four stages of longitudinal development in schizophrenia: the initial, the advanced, the preterminal, and the terminal. His first stage is the period of onset, and second stage is characterized by all of the classical symptoms during which the subject appears to become adjusted to a schizophrenic way of life. The third stage involves various odd habits such as hoarding and self-decoration, while the fourth stage is thought of as sometimes being signaled by increased activity "in which it seems almost as if we have reached a stage where psychology and neurology coalesce" (1955, p. 361).

The poverty of descriptive data concerning the later stages of schizophrenia is noted by Arieti in the following statement:

> Whereas the first stage of schizophrenia has been intensely studied by many psychiatrists from a dynamic point of view, and the second stage has been studied in great detail by the early descriptive authors, the third and fourth stages have been relatively neglected. . . . The classical symptoms of schizophrenia . . . are no longer prominent at these stages, so that many observers may have felt that the patients did not present

> symptoms worth reporting. They have described these patients as approximating more and more a vegetative existence, and a state of "idiocy." The result is that even from a simple, descriptive point of view, relatively little is known about these patients (1955, p. 350).

Arieti's first stage seems to correspond with the common usage of the term "acute" while the remaining stages correspond with the term "chronic." The delimitation of the remaining stages, if practical, would undoubtedly be useful as a classification system. He says that the third or preterminal stage occurs generally from 5-15 years after the beginning of the illness, but he recognizes the limitations of applying such a system of classification:

> In fact, the same stage of regression which is reached by a patient in a period of a few days or weeks, may be reached by another patient in a period of over half a century. A third difficulty consists of the fact, so well known, that different levels of regression do not appear in any case in pure culture, any case presenting a mixture of several stages (Arieti, 1955, p. 322).

Furthermore, his statement that the classical symptoms of schizophrenia are no longer present in the third and fourth stages is difficult to reconcile with the fact that the vestiges of the symptoms which characterize the earlier stages continue to flare up and never subside in some patients. Thus, while Arieti's stages are interesting from a theoretical point of view, they are not sufficiently

explicit for use as experimental criteria.

Despite the lack of standard criteria, clinical observations of marked behavioral differences between early and late cases of schizophrenia have led an increasing number of investigators to recognize the need for a distinction along these lines.

Related classification attempts. Distinctions, roughly along the chronicity dimension, have been advocated by some recent authors. Becker (1956) and Kantor, Wallner, and Winder (1953) have described "process" and "reactive" schizophrenias. "Process" schizophrenia is defined by gradual onset, regression in time, poor prognosis, and supposedly organic etiology. "Reactive" schizophrenia is characterized by a relatively uneventful early life development, abrupt onset associated with identifiable precipitating events, and relatively short duration, hence a more favorable prognosis.

Wishing to avoid the organic etiological assumptions of the process-reactive dichotomy, but still seeing the need for a roughly similar distinction, Rodnick and Garmezy (1957) have proposed "good" and "poor" premorbid adjustment as a classification system. These authors and others have conducted experiments demonstrating differences in psychological functioning between these groups.

Those described as "reactive" schizophrenia or as with "good" premorbid adjustment coincide considerably with short term acute schizophrenia, and the "process" or "poor" premorbid adjustment patients coincide considerably with chronic schizophrenia.

The Experimental Literature

Before considering the experimental literature in detail, it is important to stress the fact that special hazards exist in drawing inferences from the comparison of these experiments with one another. Each has generally dealt with different ranges of chronicity. Furthermore, the extent to which sampling biases have entered into the results cannot be estimated in most instances. Sampling bias often occurs, sometimes unwittingly, by the selection of only those patients who can perform a complex experimental task or who meet some other criterion of cooperativeness. The assumption that more severely disorganized patients are essentially like the patients in such a sample may not be warranted, and, in fact, different psychological processes may be at work in the two groups (Rosenthal, Lawlor, Zahn, & Shakow, 1960).

Experimental and clinical indications are that a cross-section of chronic schizophrenic subjects will include many

who are deteriorated or disorganized. For this reason, experiments which have employed tasks requiring articulateness or complex responses (Rorschach, TAT, MMPI, complex experimental procedures, etc.) have been by-passed for those employing more simple procedures.

Even though simple procedures have been employed, some experiments have dealt with psychological levels of functioning of considerable importance to the understanding of chronic schizophrenia. Experiments have been chosen for review which pertain to three main categories of psychological functioning: (a) deficits in simple overt responses; (b) attention, set, and levels of arousal; and (c) withdrawal as measured by psychophysiological responsiveness to a range of relatively simple specific stimuli. Each of these three interrelated areas of investigation have been stressed as basic in the schizophrenic process by various authors. The review will serve the purpose of setting forth the problem areas and specific considerations which are thought to be important in a study of chronic schizophrenia.

Overt voluntary responses. The literature is replete with observations which indicate the existence of deficits in overt responses of chronic schizophrenic subjects. H. E. King (1954) has ascribed this phenomenon to psychomotor

deficit, while Malmo, Shagass, and Smith (1951) stressed "purposive" behavior as the main area of deficit.

While investigations of psychomotor behavior have been neglected in schizophrenia in comparison with studies involving more complex verbal and perceptual tasks (Rabin & G. F. King, 1958), the thorough work of H. E. King (1954) compensates, to an extent, for the limited number of studies in this area. Employing individual tests of motor behavior, i.e., speed of tapping, finger dexterity, peg board, and reaction time, he examined several groups representing different degrees of severity of psychopathology, including chronic schizophrenic subjects. His data clearly indicate a relationship between defective psychomotor performance and degree of psychopathology, the most chronic schizophrenic group showing the greatest performance deficits.

In his conclusions, H. E. King stressed the involvement of psychomotor performance as a central or core problem in schizophrenia and the "behavior" disorders:

> Psychomotor capacity appears to be disturbed in a fundamental sense in the behavior disorders. As such, it is a reflection of defect at the core, rather than in the periphery, of mind and mental process. Those suffering from mental disease are, by definition, as well as current theory, persons who demonstrate a faulty adaptation to their environment. Retarded and faulty psychomotor response is regarded as a basic indication

> of this state of psychobiological maladaptation (1954, p. 156).

A different explanatory emphasis was given by Malmo et al. (1951), who also reported deficits in voluntary motor responses to pain-stress, despite the fact that autonomic indices of emotion were essentially comparable with those in control subjects. They concluded that those aspects of responsiveness associated with emotional arousal seem intact while purposive acts seem defective or inoperative.

H. E. King's (1954) assertion that psychomotor deficit is a "core" problem in schizophrenia, in the sense that it is basic in its own right, was questioned by Rabin and G. F. King (1958). The description by Malmo et al. of deficit at the level of "purposive acts" more satisfactorily extends the generality of the explanation beyond the simple motor area to goal directed responses.

Without exception, it seems that deficits in overt responses are found in chronic schizophrenic subjects. In the present review, studies are considered which go beyond this superficial observation in order to seek the possible underlying bases of these response deficits. One such line of investigation concerns levels of arousal. Closely related to levels of arousal are studies of "attention" and "response

set."

Attention, response set, and levels of arousal. Schizophrenic subjects in chronic stages are often characterized as indifferent to the world about them. They appear not to spontaneously study their surroundings and do not evidence the usual amount of curiosity or interest in the routine things of life, i.e., they manifest a general lack of attention or set to perceive. On the other hand, their attention and involvement in events can sometimes be gained for brief periods in respect to specific things when the initiative is provided by another person. This phenomenon is evident in two experiments of incidental learning.

Winer (1954) advanced the hypothesis that incidental learning characterizes the behavior of normal subjects to a greater extent than schizophrenic subjects. His conclusions supported this hypothesis. Except for the paranoid group, the schizophrenic subjects failed to manifest a normal amount of incidental learning. Greenberg (1954) found that a group of chronic schizophrenic subjects failed to observe objects and relationships toward which their attention had not been directed. Even after differences in directed learning scores were corrected by co-variance procedures, the normal subjects were clearly superior on two of three incidental learning

tasks. Thus, the attention of schizophrenic subjects apparently can be directed toward material to be learned with fair results, while materials to which their attention is not directed is not learned as readily as by normal subjects.

Incidental learning and set have been related in the statement that "the hypothesis becomes reasonable that set is a basic determiner of the learning called 'incidental'" (McGeoch, 1942, p. 308). In this context, the term "set" is associated with "attention" or "set-to-perceive." Another aspect of set or preparedness has been referred to as "set-to-respond." "Set-to-perceive" and "set-to-respond" are both important as possible areas of deficit in chronic schizophrenia.

The importance of "mental set" in the psychology of schizophrenia has been stressed by Huston, Shakow, and Riggs (1937). They concluded that schizophrenic patients do not attain a high level of set or "preparation for response" compared with normal subjects and are unable to maintain a level of preparation as consistently.

A series of studies of response set, using variations in the length of preparatory intervals between warning signals and signals to respond, have been reported (Knehr, 1954; Rodnick & Shakow, 1940; Tizzard & Venables, 1956). In

their critique of this work, Rosenthal et al. (1960) concluded that for preparatory intervals between 4 and 7.5 seconds the amount of loss of set correlated significantly with degree of mental health. Their own subjects had been hospitalized for schizophrenia an average of 10.7 years.

These data are not contradictory with findings of overt-voluntary response deficits or of psychomotor deficits, as end products, but they tend to explain such defects as a failure in chronic schizophrenic subjects to establish and maintain preparations for response rather than as a motor deficit or as an inhibition of a prepared response.

Thus, both "set-to-perceive" and "set-to-respond" have been shown to be impaired in chronic schizophrenic subjects. The difficulty has been attributed both to establishing and maintaining sets. The simultaneous study of these phenomena, in the same subjects, will be helpful in clarifying their relative importance as areas of deficit in chronic schizophrenic subjects.

What seems needed in such a study is a common index of the effects of set. One line of investigation which appears not to have been extended to the study of set in chronic schizophrenia is that of autonomic activation. Levels of autonomic activation as well as autonomic reactions to

specific stimuli have been studied through the phenomenon of galvanic skin response for many years. The application of this technique to the study of set as well as other relevant comments may be found many places in the literature. Duffy has summarized the essential points:

> "Energy mobilization" refers to the release of potential energy . . . for use in activity or response. This energy may be used for either covert or overt activity. It is the energy used in attending and thinking as well as in locomotion and manipulation. It is the energy used in tensing the muscles in preparation for overt response as well as that used in the overt response itself. . . . The energy mobilization itself appears to be directly controlled by the autonomic nervous system. . . . Whatever may be the precise nature of the phenomenon, there appears to be consistent variation in skin resistance with variations in the energy demands of the situation. This fact suggests that the measure may be employed as an indicator of energy mobilization. . . . In other studies the galvanic responses to words have been shown to vary with the meaningfullness and importance of the words. . . . Apparently, activity, or readiness for activity, is the common factor in all situations where low skin resistance is found in a given individual. Relaxation or passivity, on the other hand, appears to be the common factor in all situations where high skin resistance is found. If a decrease in resistance occurs (with certain limitations) whenever there is an increase in energy mobilization, it is not surprising that decreased resistance has been variously considered to be characteristic of emotion, of volition or conation, of a sudden check in the comprehension of problems, and of states of alertness (1951, pp. 33-36).

Not only may skin resistance (or conductance) be used as a measure of reaction to specific stimuli but shifts in levels of activation should permit the study of attention and

response set.

A number of studies have been reported in which level of activation of psychophysiological background activity has been measured during various experimental conditions. As distinct from momentary reactions to specific stimuli, the activation level has been associated with the ongoing intensity of emotional activity. Darrow and Solomon (1934) concluded that a relation appears to exist between a large amount of free energy (anxiety) and low electrical skin resistance and between a small amount of free energy and high electrical skin resistance. These authors emphasized that, to understand the relation of overt responses to various stimuli, it is necessary to know the physiological and emotional state of the patient at the time of the behavior.

The relation of physiological activation to alertness and responsiveness has also been described by Woodworth and Schlosberg (1958). Silverman, Cohen, and Shmavonian have given a detailed statement of the concept:

> As the arousal state of the organism increases, a number of changes occur. From a state of inattention to external events associated with poor and sluggish motoric activity and decreased ability to react to external stimuli, the organism becomes a more alert, wakeful and vigilant individual, characterized by facilitated psychomotor performance focused attentiveness to significant meaningful stimuli and the ability to react

> more appropriately to stimuli with organized, goal-directed behaviour. However, as he becomes more aroused and more activated, he may become panicky, unable to focus or constrict his attention on appropriate goal-directed tasks. His behaviour may become hyperactive and more disorganized. He is unable to perceive, integrate or to react to reality situations because of the intense, continuous, internal disruptive activity in the central nervous system (1959, p. 68).

This suggests, considering their behavioral manifestations, that chronic schizophrenic subjects may fall in one extreme or the other of the above paradigm. The activation levels found in chronic schizophrenic subjects by various investigators has led to conflicting impressions. While this confusion may be attributable to sampling variations, those reporting studies of patients with greater degrees of chronicity tend to report lesser activation levels. Likewise, subjects with greater clinical manifestations of withdrawal are often reported to be less activated.

Syz (1926) and Syz and Kinder (1928) reported that the frequency of skin resistance responses to specific stimuli was greater in patients when skin resistance levels were low (normals and paranoids) and less when skin resistance levels were high (catatonics and depressives). However, Williams (1953) found, in schizophrenic subjects who had been hospitalized only 1-3 years, a higher level of psychophysiological background activity (low skin resistance levels) and

simultaneously less responsiveness to stresses of a psychological nature than normal controls. Conversely, Jurko, Jost, and Hill (1952) reported that a group of "early" paranoid patients manifested consistently higher skin resistance levels before and after psychological stress, although they also showed smaller increments in activation following stress and diminished GSRs to specific stimuli, compared with normal controls. Yet, Howe (1958) found a higher skin resistance level in schizophrenic subjects with over 5 years of chronicity than in normal and anxiety subjects.

Howe was primarily concerned with conditioning of GSR with electric shock stimuli. He found that 36 of 96 schizophrenic subjects were not conditionable because of zero GSRs to shock, complete GSR adaptation to shock during acquisition trials, or failure to give any response on the first and subsequent acquisition trials. He found that the unconditionable group had been given stronger shock, showed much higher skin resistance levels, were an average of 4.5 years older, and had been ill for an average of 7 years longer when compared with the 60 schizophrenic subjects who were conditionable. He concluded that the behavior of a schizophrenic in a nociceptive conditioning situation will be a function of the degree of chronicity and perhaps the deteriorative

character of the psychosis.

The evidence, particularly that of Howe, is consistent with the hypothesis that schizophrenic patients with a moderate or great degree of chronicity may be characterized as being at a low level of activation (high skin resistance level), in a state of inattention to external events associated with poor and sluggish motoric activity and decreased ability to react to external stimuli. This conception of chronic states is opposite to what has often been described for acute states in which "withdrawal" is associated with overwhelming anxiety and a high level of internal disruptive activity (anxiety).

Additional literature has been devoted to immediate skin resistance responses (GSR) to specific stimuli. The range of stimuli to which these subjects will respond has been an issue in assessing the level of withdrawal.

Withdrawal and responsiveness to specific stimuli. For many years, authors in the field have described "emotional withdrawal" as a prominent feature in schizophrenia (Angyal, 1941; Arieti, 1955; Arieti, 1959; Bellak, 1948; Bellak, 1958; Cameron & Magaret, 1951; Hoskins, 1946). According to Cameron and Magaret:

> If seclusion cannot be achieved merely by moving

> out of the range of stimulation, then it must be done by inhibiting one's reactions to stimulation. . . . And this can be so intensively developed, by some individuals, as to shut out effectively the whole disorganizing environment (1951, p. 244).

There are also instances in which withdrawal has been described at the level of overt response rather than at the level of perception. This concept has been particularly stressed in respect to catatonic states but has been generalized to chronic schizophrenic subjects by some authors (H. E. King, 1954; Malmo et al., 1951). This concept is illustrated in the following statement:

> After recovery from what seemed a catatonic "stupor" the patient explained that the reason for his immobility was that the forces of "good" and "evil" were having a fight in the universe, and his least movement would have influenced the outcome of this fight (Deri, 1949, p. 193).

McReynolds states that the most dramatic example of schizophrenic withdrawal is catatonic stupor and that evidence indicates this condition is not due to a deficit in motor capacity and that it is not a sleeplike condition. He says:

> Not only does the catatonic patient avoid participation in social interactions and normal activities, but also--and in particular--his inhibition on action permits him to avoid having percepts of self-initiated movements. That it is the perception of movements, rather than movements per se, which is avoided is indicated by the fact that the patient's sleep movements

> are normal. It is as if the patient had developed a selective avoidance of percepts concerning self-initiated action (1960, p. 267).

Forbes and Piotrowski found that catatonic schizophrenic subjects showed more activity than normals during sleep. They said:

> We may tentatively conclude that the larger and more frequent variations shown by catatonics indicated a greater instability and variation of activity in autonomic function in catatonics than in normals, at least during sleep. . . . Such automatic functional variations should be sharply distinguished from low "vegetative-emotional" reactivity ("psychogalvanic reflex") to lists of words or questions in catatonics reported by Odegaard [1930] . . . since the latter involves an external stimulating situation of a complicated nature (1934, pp. 722-727).

While the above citations indicate that these patients are quite active during sleep, when awake similar patients show reduced responsiveness to specific stimuli.

Syz (1926) and Syz and Kinder (1928) reported studies in which 100 words, an auto horn, pin pricks, and threat of pin pricks were stimuli, using skin resistance changes as a measure of emotional response in normal and schizophrenic subjects. Without systematically distinguishing between the effects of the different stimuli they indicated that skin resistance responses were fairly regular and with good amplitudes in normal subjects while paranoids, in spite of a high total number of galvanic waves, gave fewer reactions

which were closely connected with the experimental stimuli. Catatonic patients were reported to show the least responsiveness to outside stimuli. The authors stressed the fact that even sensory stimuli failed to produce a deflection of the galvanic string in some patients. These findings, they concluded, would indicate such a patient's complete emotional detachment. One catatonic patient even failed to produce a galvanic response to deep breathing.

A question may be raised as to whether this lack of responsiveness was due to a biological fault rather than a psychological state. Hoskins (1946) said of these patients that lack of responsivity to a variety of stimulating agents might well be regarded as an indication of schizophrenic withdrawal at the somatic level. On the other hand, the finding of Forbes and Piotrowski that considerable lability is present in catatonics during sleep is supported by the statement of McReynolds that such patients' sleep movements are normal. This suggests that the lack of responsiveness in patients while awake may have been due to psychological factors associated with the awakened state, e.g., emotional withdrawal rather than biological fault.

Since skin resistance is not ordinarily considered to be an overt-voluntary response, the suppression of this

function has been interpreted to mean that involuntary affective responses were "flat" or "blunt" in schizophrenic patients.

Support for the position that changes in the psychological state can and will alter skin resistance to specific stimuli (GSR) is found in a report of West, Niell, and Hardy (1952). Using the method of hypnosis, they were able to demonstrate, in normal subjects, a reduction of sensitivity to stimuli as reflected by GSR responses. Further, Darrow and Solomon (1934) studied GSR and blood pressure reactions to crucial ideational stimuli, selected especially for each subject. Small blood pressure reactions together with small galvanic reactions to all forms of ideational and to sensory stimuli tended to be associated with lack of "contact with reality" as judged clinically.

Thus, for several years, the trend in the experimental literature and clinical reports seemed consistent with the view that emotional responsiveness or sensitivity to stimuli in schizophrenic subjects was diminished. The evidence was usually interpreted to mean that the patients were "emotionally withdrawn" or were suffering a "loss of contact with reality."

This line of thought was reversed in a study by Malmo

et al. (1951). In their previously mentioned study with 17 chronic schizophrenic males scheduled for lobotomies due to behavior problems, the authors, using a pain-stress stimulus (thermal radiation on the forehead), reported autonomic responsiveness equal to normal subjects. At the same time, the schizophrenic subjects did not voluntarily press a button to signal pain as readily as the control subjects. Based upon these findings, the authors distinguished between involuntary affective (autonomic) responses and voluntary "purposive acts." They concluded that those aspects of responsiveness associated with emotional arousal seemed intact while voluntary acts seemed defective or inoperative in the patients. This position seems antagonistic to the concept of "emotional withdrawal" or "withdrawal from contact with reality" and supportive of the theory that withdrawal primarily involves the withholding of overt-voluntary responses or "purposive acts."

With this finding it seems necessary to consider the possibility that stimulus differences are important and that schizophrenic subjects may be responsive or sensitive to some classes of stimuli and unresponsive or insensitive to others. It seems necessary also to reexamine the status of physical pain stimuli. The interpretation given by Malmo et

al. (1951) regarding emotional responsiveness is subject to question on what may be a crucial technicality, that physical pain as a stimulus may produce unconditioned reflex activity in the autonomic system which is different in principle from emotional reactions associated with psychologically meaningful stimuli.

A discussion by Walter (1960) of differences in latencies of GSR to conditioned and unconditioned stimuli with essentially normal subjects may be used to illustrate this point. Three kinds of stimuli were used: a warning tone, a flashing light, and a painfully loud penalty sound which was disagreeable enough to provide a powerful incentive and evoke large consistent GSRs; it was in effect a specific or unconditioned stimulus. GSRs following the UCS had short latencies while those following neutral or conditioned stimuli had longer latencies, the distribution being bimodal with almost no overlap between the two categories. Walter concluded:

> Unconditional responses to specific stimuli can be considered legitimately as instinct in the literal if not the literary sense, . . . they require neither discrimination nor internal reflection though they are reflexive in their mechanism. They must therefore depend upon a diffuse transmission, not to the cortical levels so much as to the hypothalmic and autonomic effector pathways (1960, pp. 673-790).

Transmission of conditioned stimuli on the other hand involves

"cortical analysis," according to Walter.

On this basis, pain stimuli may be considered to result in unconditioned reflex activity, a matter which is quite different from that commonly associated with emotional responses to psychologically meaningful (conditioned) stimuli. The question is raised, therefore, of whether Malmo et al. were dealing with unconditioned reflex activity rather than emotion associated with psychologically meaningful stimuli.

Although they used overt responses only, Hall and Stride (1954) systematically investigated pain tolerance (heat on the forehead). The 14 schizophrenic subjects in their sample, 11 of whom were under 30 years of age, tended to vary considerably, both intraindividually and within the group, but the overall thresholds for the group were very high both in verbal report of pain and withdrawal movements. According to Hall and Stride:

> This, of course, is not at all an unexpected finding in view of the withdrawal and indifference to external stimuli shown by many schizophrenics, but it is necessary to stress the point in connection with the work of Malmo and Shagass (1949) on the motor response of schizophrenics to a fixed set of so-called "painful" stimuli. There seems to be no justification whatever for assuming such patients to be "perceptually normal." In such patients, there will, as Malmo and Shagass observed, be no adequate directed motor response, but this may be due primarily to the fact that the afferent stimuli are not perceived and conceptually related to

> pain, and that the "mental set" towards the task introduced by the form of the instructions is relatively ineffective (1954, pp. 48-60).

Similarly to Malmo and Shagass (1949) and Malmo et al. (1951), Hall and Stride found overt pain reactions to be diminished in schizophrenic patients. Although they did not measure autonomic indices, they were critical of the position taken by Malmo and his associates that perception and affect are normal. Hall and Stride apparently believe, although autonomic indices may be present, that the afferent impulses are not conceptually related to pain by the patient. This is similar to the point made in connection with the discussion of conditioned and unconditioned stimuli. It leads to the position that the schizophrenic subjects do not perceive, as pain, their own unconditioned autonomic reactions to a pain stimulus. As matters stand, the question of response to pain seems to be in an impasse, lost between the two indices of perception and emotion, autonomic response and overt report or overt behavior.

Hall and Stride leave only one alternative in their discussion, that the "mental set" induced by instructions did not provide a ready means for communication of perceived pain sensation by the schizophrenic subjects.

In an effort to study the extent to which "early" chronic

schizophrenic subjects were emotionally responsive to stresses of a more psychological nature, Williams (1953) used a three minute motion picture of a close-up death struggle between a cobra and a mongoose, a word association procedure under somewhat intimidating circumstances, and an increasingly frustrating series of problems under failure-censure conditions. His subjects were 18 patients who had been hospitalized approximately 1-3 years and an equal number of hospital employees for controls. The measures were skin resistance levels, pulse rate, and respiration rate. Over all conditions, the schizophrenic subjects showed less shift in level of activation from rest to stress periods, and following stress periods less physiological recovery was seen than in the controls. Compared with the controls, the patients were little affected by the symbolic threat posed by the death struggle film and showed their greatest response to the conditions in which more active participation was induced and in which stress was a part of the situation. Williams concluded that his chronic schizophrenic subjects were "withdrawn" and that their emotional responsiveness was "dampened" or "blunted."

Combining the Malmo et al. (1951) and Williams (1953) studies, the least effective stimulus in the two experiments

apparently was one which might be expected to elicit anxiety from within the subject on the basis of his own fantasies as he viewed the film of the death struggle between the cobra and the mongoose. The next most effective were those which involved situational pressure; one stressed interpersonal disclosure of associations to words and the other stressed failure and censure. Finally, Malmo et al. administered actual pain stimulation which appeared to have been as effective in the patients as in the normal control subjects. It is possible, therefore, that a hierarchy of stimuli exists in respect to their capacity for eliciting an emotional reaction in chronic schizophrenic subjects. An added class of stimuli used by Syz and Kinder (1928) was threat of pain and, although the effect of this stimulus was not compared with other stimuli in their report, it seems that it could fall near actual pain in the hierarchy since it might elicit a protective reaction in an immediate sense.

It is evident in the studies reviewed in this section that the concept of withdrawal is prominent in describing chronic schizophrenia. However, a controversy exists as to the level at which withdrawal occurs, i.e., at the level of perception, affect, or overt-voluntary response. In addition to the level at which withdrawal occurs, the classes of

stimuli which elicit responses have been considered, and it has been proposed that a hierarchy of stimuli may be involved and that chronic schizophrenic patients, compared with control subjects, will be less responsive or more withdrawn in respect to conceptual, emotionally toned, psychological stimuli, but will be relatively less detached in respect to threat of pain and pain stimuli. The outcome is by no means certain, in spite of the report of Malmo et al. (1951) that autonomic responsiveness to pain-stress was intact in his patients (who, incidentally, were somewhat atypical behavior problems), since Howe (1958) reported a high percentage of his very chronic group to be autonomically unresponsive to pain (electric shock).

Summary. The psychological functioning of chronic schizophrenic subjects has been investigated from several points of view which seem interrelated, but which have been studied mainly as isolated phenomena in different groups of subjects. Overt-voluntary response deficits have been virtually a unanimous finding while investigations of the less obvious intervening processes have produced only fragmentary and sometimes conflicting results.

One of the earliest and continuing lines of investigation has been the study of withdrawal via autonomic indices

of affective response to various specific stimuli. The early authors stressed the general diminution of autonomic responsiveness to all classes of stimuli and interpreted these findings as evidence of general withdrawal. Later investigators have cast doubt on the generality of this phenomenon by showing that pain stimuli may produce adequate autonomic responses concurrently with inadequate overt-voluntary responses in chronic schizophrenic subjects. The more recent findings have been interpreted to mean that withdrawal is not so much at the level of affective responsiveness but as an aspect of overt-voluntary or "purposive" responses. A study comparing a range of psychological and physical pain stimuli in the same subjects is clearly required to clarify the status of this problem.

Furthermore, autonomic activation, attention, and response set have each been implicated in the chronic schizophrenic process. While these concepts seem closely related, their relationships to one another and to responses to stimuli have not been empirically demonstrated in the same group of chronic schizophrenic subjects.

As a step in laying the groundwork for a more general theory of the psychology of chronic schizophrenia, these problem areas need simultaneous investigation in the same group of subjects which meet a clear standard of chronicity.

CHAPTER II

STATEMENT OF THE PROBLEM

The weight of evidence from separate experiments leads to the impression that chronic schizophrenia is characterized by withdrawal associated with low levels of autonomic activation, inattention to external events, failure to organize and maintain response sets, poor and sluggish overt-voluntary responses, and decreased autonomic reaction to external conceptual stimuli but adequate responses to more proximal physical pain stimuli.

While all of these impressions are by no means well established facts, in the present experiment the specific experimental hypotheses have been stated to be generally consistent with this formulation, and the individual acceptance or rejection of the hypotheses will make possible a more accurate general statement concerning the psychology of chronic schizophrenia.

A series of hypotheses concerning these issues may be tested if galvanic skin responses are measured continuously

in a group of chronic schizophrenic subjects and a group of normal control subjects before and during the following stimulus conditions: "loaded" and "neutral" words during set-to-perceive (but not respond verbally), "loaded" and "neutral" words during set-to-respond verbally, verbal threat of pain, touch (prepare finger with cotton and alcohol), sham pain, and physical pain stimulus (pierce finger). The specific hypotheses and their rationale follow. --

Levels of Autonomic Activation During Set-to-Perceive and Set-to-Respond

Preparatory sets. Previous experimental literature has provided indirect evidence that chronic schizophrenic subjects are defective in "mental set" both in respect to preparations to attend and preparations to respond. Therefore:

1. In response to instructions but prior to presentation of stimulus words (in a word association task), chronic schizophrenic subjects will show smaller increases in autonomic activation levels than will normal control subjects.

Maintenance of sets. Previous indications are that chronic schizophrenic subjects have difficulties not only in establishing sets but also in maintaining sets. Therefore:

2. When instructed to attend or listen and think about stimulus words (set-to-perceive but not respond verbally)

during the stimulus series, chronic schizophrenic subjects will show less sustained autonomic arousal than will normal control subjects.

In respect to maintaining sets while overt verbal responses are required, a somewhat different situation arises. It will be remembered that withdrawal and overt-voluntary response deficits are characteristic of chronic schizophrenic subjects. This suggests the possibility that greater than normal mobilization or activation will be required for those who produce overt responses of an adequate nature. Therefore:

3. Compared with normal control subjects, those chronic schizophrenic subjects who produce minimally adequate verbal responses will do so with a greater increase in levels of activation compared with a previous condition in which responses were not required.

The Effect of Set-to-Perceive and Set-to-Respond on Specific Autonomic Responses to "Loaded" and "Neutral" Words

While normal control subjects are expected to give differential GSRs to "loaded" vs. "neutral" words in both conditions of set, in the set-to-perceive condition the chronic schizophrenic subjects are not expected to give differential GSRs to the word classes. However, previous studies on

"directed learning" have indicated that these subjects can be induced to attend under some circumstances. It seems reasonable to assume that a greater degree of involvement in the situation will be produced when the chronic schizophrenic subjects actually give verbal associations to the words and that a greater differential amplitude of autonomic responses between "loaded" and "neutral" words will be the result. Therefore:

4. Compared with normal control subjects, those chronic schizophrenic subjects who give minimally adequate verbal responses will respond with greater amplitudes of autonomic responses to "loaded" compared with "neutral" words in the set-to-respond series than in the previous set-to-perceive (no-response) series.

Specific Autonomic Responses to the Threat-Pain Stimulus Series

According to the weight of evidence from previous experiments it is expected that chronic schizophrenic subjects will be relatively indifferent to all but the physical pain stimulus. Therefore:

5. Compared with normal control subjects, chronic schizophrenic subjects will be less responsive autonomically

to all threat-pain stimuli except the physical pain stimulus.

Overall Levels of Autonomic Activation

Although there has not been universal agreement between authors, the weight of previous experimental evidence suggests that chronic schizophrenic subjects may function at a lower level of autonomic activation than normal subjects. While physical health factors may be involved, lower levels of activation would be consistent with a psychological interpretation of apathy or lethargy. Therefore:

6. Compared with normal control subjects, chronic schizophrenic subjects will show lower levels of autonomic activation throughout the experiment.

CHAPTER III

METHOD

Subjects

The experimental group was 34 randomly selected female chronic schizophrenic patients from Central State Griffin Memorial Hospital, Norman, Oklahoma, who had been hospitalized a minimum of 8 years. The control group was 20 female ward attendants who participated as paid volunteers.

Random selection of the experimental subjects was accomplished in two stages. A group of 60 women were selected at random and housed on a special research ward in December of 1957. These subjects met the following criteria at that time:

Diagnosis: Schizophrenia
Minimum hospitalization: 5 years
Age: 25-50 years
No recorded evidence of: mental deficiency, epilepsy, CNS syphilis, or other types of organic brain disease
No history of brain surgery of any type
No record of: metabolic disease, liver disease, or heart disease

These criteria assured the chronicity of the illness and eliminated the confounding effects of distress due to physical illness or handicap due to the effects of known brain damage and the contaminating effects of treatments for the physical diseases. Approximately 600 female patients in the hospital met the first three criteria but less than 200 met all criteria. Since their original selection the patients have advanced in age and hospitalization approximately 3 years. The 60 patients participated in a previous experiment in which the effects of chlorpromazine, phenobarbital, and placebo were studied (Clark et al., 1961). The drug treatment phase of the previous experiment ended in August of 1959, 17 months before the collection of the data in the present experiment. Since that time no individual therapies of any kind have been used. The present experiment, therefore, is provided with a group of subjects who are free of the effects of therapies which might distort the performance of the subjects. The group is representative of chronic schizophrenia uncontaminated by extraneous factors, which provides an exceedingly rare research opportunity.

For this experiment, subjects were selected at random (table of random numbers) from the pool of 60 subjects previously described. When the goal of 20 minimally adequate

verbal responders had appeared in the experiment (based on judged adequacy of verbal associations), 14 inadequate verbal responders had also been run. Two patients were omitted; one was in seclusion and one was very agitated and could not stay in the chair.

The diagnosis of chronic schizophrenia for each subject was confirmed by a research psychiatrist and classified according to the prevailing symptoms. In this regard it may be noted that differential diagnoses after several years of schizophrenia are often meaningless. This can be seen in the fact that the records of individual patients, through the years, often carry a series of different diagnoses, the impression of each new psychiatrist being different from the last. According to Arieti (1955), in these later stages, it is difficult to distinguish a catatonic from a paranoid and different types converge toward one another. Nevertheless, the most recent diagnoses, as well as other characteristics of the sample, are reflected in Table 1, effective in January of 1961, the month in which the data were collected.

The normal control subjects were 20 paid volunteer female psychiatric aides from the same hospital. This class of control subjects was selected because of the general similarity of their social and economic backgrounds to those

Table 1

Experimental Subjects and Background Information

S no.	Age	Yrs. hosp.	Diagnosis[a]	EST[a]	Insulin comas	Relatives in hosp.
			Minimally Adequate Verbal Responders			
21	48	21	Para.	32	0	1
22	40	13	Simp.	0	0	1
23	45	11	Hebe.	0	1	0
24	44	11	Cata.	48	57	0
25	53	20	Para.	80	0	0
26	49	20	Simp.	1	0	0
27	45	12	Para.	52	0	1
28	53	16	Para.	21	0	1
29	46	12	Para.	1	0	0
30	46	12	Para.	14	0	1
31	35	12	Hebe.	70	0	1
32	47	12	Para.	53	1	1
33	49	24	Para.	32	0	0
34	50	21	Hebe.	187	0	1
35	52	13	Simp.	6	30	1
36	53	14	Para.	0	0	0
37	55	8	Para.	7	1	0
38	48	28	Simp.	26	0	0
39	42	15	Hebe.	211	1	1
40	52	11	Simp.	35	34	1
Mean	47.6	15.3		43.8	0.4	0.6
			Inadequate Verbal Responders			
41	52	12	Simp.	7	0	1
42	45	9	Para.	16	70	0
43	49	23	Hebe.	44	99	1
44	37	19	Cata.	64	0	0
45	40	9	Simp.	12	1	1
46	48	24	Cata.	10	60	0
47	48	26	Cata.	27	0	1
48	35	20	Simp.	0	0	0
49	49	23	Hebe.	0	0	0
50	48	27	Cata.	19	0	0
51	45	11	Cata.	12	0	0
52	42	12	Cata.	139	46	1
53	50	20	Cata.	1	0	1
54	48	17	Cata.	292	1	0
Mean	45.4	18.0		45.9	0.4	0.4

[a]Cata. = Catatonic; Hebe. = Hebephrenic; Para. = Paranoid; Simp. = Simple; EST = Electric shock treatment.

of many of the experimental subjects and because of their familiarity with routine matters in the hospital which they share with the patients, albeit from different points of vantage. Within limits, the control subjects are similar in ages to the experimental group (Table 2).

It should be noted that the experimenter had been acquainted with this particular group of patients for over three years and that personal rapport had been established before the experiment in most cases. The same is true, to some extent, in the case of the control subjects, most of whom were speaking acquaintances of the experimenter.

Skin Conductance and Word Association

Galvanic skin response, as a sensitive indicator of affective reactivity to physical and psychological stimuli has been known since Féré's work in 1888 and Tarchanoff's in 1890 (Woodworth & Schlosberg, 1958). It has a long and continuous history of use in the evaluation of states of autonomic activation thought to be associated with emotion (Duffy, 1951; Freeman, 1948; Woodworth & Schlosberg, 1958). It may also be noted from the literature already cited that the technique has been used repeatedly in the study of variables like those in this experiment.

Table 2

Normal Control Subjects

S no.	Yrs. work in this hosp.	Age
1	11	49
2	3	32
3	5	30
4	3	44
5	3	35
6	1	50
7	8	44
8	2	46
9	12	40
10	10	39
11	4	40
12	7	59
13	2	40
14	11	54
15	4	42
16	2	32
17	5	35
18	3	51
19	5	42
20	3	49
Mean	5.2	42.7

Although both continue to be used, some sources indicate that skin conductance rather than skin resistance may have certain properties more congenial to statistical analysis. After examining a variety of transformations of galvanic skin response data, Haggard said:

> Of the four measures examined in this study, the log conductance change best satisfies the criteria of additivity, normality, homogeneity of variances, independence of means and variances, randomness, and maximal precision (1949, p. 390).

Lacey and Siegel (1949) favor conductance change rather than log conductance change, but the choice of transformations (if needed) is undoubtedly to be determined more by the data at hand than by data in some other experiment. On the basis of these recommendations, however, it was decided to measure galvanic responses in conductance units and to further transform the data only when warranted. It makes little practical difference whether the data are expressed as resistance or conductance units since conductance is merely the reciprocal of resistance. Conductance has the advantage of simplicity as a measurement concept since autonomic activation increases directly with conductance but inversely with resistance. Edelberg (1960) also favors conductance as an expression for electrical changes in the skin for reasons he calls "biophysical."

The status of the word association technique has been reviewed in Woodworth and Schlosberg (1958). Words of different affective connotation have been shown to produce differential affective responses (Haggard & Jones, 1947; Hull & Lugoff, 1921; Jones & Wechsler, 1928). The frequent use of GSR among other indicators as an index of affective response to words of different affective value has led to a well established relationship between the techniques. Literature has already been cited showing the use of these techniques in mental disorders.

Apparatus

The experimental room was located in the same building and on the same floor as the ward in which the experimental subjects were housed. All subjects were familiar with the area and the patients had all previously been in the experimental room for psychological testing, which undoubtedly served to lessen the apprehension of these subjects.

The apparatus for measuring conductance was an electrical circuit with a Wheatstone bridge arrangement and a DC amplifier (Appendix B). Two ½" diameter sealed zinc electrodes were attached to the first and middle fingers of the right hand over the apperture of a felt corn pad filled with

zinc sulphate electrode paste. Prior to attaching electrodes the finger-print whorls of the proper fingers were cleansed with alcohol and cotton. The application and properties of these electrodes is described by Lykken (1959). Preliminary trials with the electrodes confirmed the report of Lykken that they were relatively free of polarization effects. It is believed that these electrodes, of all those described in the literature, probably best insure freedom from electrical artifacts and error due to variation in the area of contact with the skin from subject to subject.

Changes in conductance across the electrodes were continuously recorded on an Esterline-Angus graphic recorder. Prior to the experiment the instrument was calibrated for each 100,000 ohm setting across the full meter range with the use of an external decade box. A series of transparent plastic reading devices was constructed which provided the experimenter with an accurately calibrated and efficient means of reading the values directly in conductance units (expressed as mhos x 10^{10}).

The graphic recorder was also equipped with two marking devices, electrically actuated by telegraph key switches, enabling the experimenter to record the occurrence of experimental stimuli and responses by the subjects synchronously

with the skin conductance record.

Stimulus Words

Two word lists were employed (Appendix A). In each list, after 5 neutral "buffer" words, 6 "loaded" words were separated by 2 "neutral" words each. Thus, each list contained a total of 22 words of which 6 were "loaded." The words were selected from existing lists previously standardized for GSR values (Hull & Lugoff, 1921; Jones & Wechsler, 1928; Woodworth & Schlosberg, 1958). After complex, obscure, and dated words were eliminated, the lists were equated to attain maximum comparability of word frequency (Thorndike & Lorge, 1944). In previous experimentation with chronic schizophrenic subjects a standard of adequacy-inadequacy of word association responses was established by the present author. Agreement between raters was highly reliable (minimum of 90% agreement). The criteria were: verbal associations are minimally adequate if they are reasonably relevant and temporally contiguous with the stimuli. They are inadequate if no verbal response is given, if a stereotyped response is given, if the subject repeats the stimulus word or spells it as a response, or if the subject gives associations out of phase with the stimuli as would be the case

with continued irrelevant mumbling.

In the present experiment ratings of verbal adequacy were made independently by the experimenter and an assistant with 97% agreement in classifying subjects. It appears, therefore, that the criteria of adequacy-inadequacy of verbal responses were clear and capable of reliable application. The single disagreement was resolved in favor of the judgement of the experimental assistant on the basis of a response-by-response examination of the record. All control subjects gave verbal associations well within the limits of adequacy.

The experiment also included a comfortable reclining chair in which the subjects reclined at a comfortable angle during the procedures. A supply of disposable blood lancets, cotton, and alcohol were also on hand.

Experimental Design and Procedures

The design of the experiment does not permit a direct comparison of stimulus conditions with one another since conditions are not counterbalanced, except within word lists in which "neutral" and "loaded" words are alternated in order of presentation.

The experiment was designed with the mild stimuli preceding the more stressful stimuli in order to avoid strong

aversive effects early in the experiment which might have overshadowed the differential effects of the more mild stimuli. To further obviate the carry-over of effects from the previous conditions, a resting condition was interpolated between the word series and the threat-pain series.

The reasons for not counterbalancing threat-pain conditions with the more mild stimuli are the same as stated by Rodnick and Garmezy:

> We have found, unfortunately, that certain niceties of experimental design are not always applicable to research in schizophrenia. For example, it has been our experience that counterbalancing the order of nonstress and stress conditions is not as effective a procedure as one in which the former precedes the latter. This is not merely a value judgement but a conviction based upon unsuccessful efforts to employ counterbalancing procedures. Our research would appear to indicate the validity of assuming that when the patient is presented with a censure condition prior to its nonstress counterpart, the experimental procedures tend to be invested with potent aversive properties (1957, p. 171).

With this consideration in mind, a test of the absolute stimulus value of the various conditions would require independent replications with newly selected groups. Thus, in the present experiment, no attempt was made to compare conditions, as such, although differential rates of change between groups across conditions form the basis for many of the main hypotheses.

The subjects were individually tested in the experiment.

The experimenter conducted all aspects of the experiment which involved interaction with the subjects, while an experimental assistant operated the electronic equipment, balanced the bridge, and marked the continuous recording tapes synchronously with instructions to subjects, experimental stimuli, and responses of the subjects.

All subjects were run in the experiment during a three week period during which weather and temperature variations were small and experimental and control subjects were systematically interspersed to distribute effects of time-of-day and day-to-day variations.

After the subjects were seated in the reclining chair, in a comfortable position (same angle for all subjects) and the electrodes were attached, the experimenter explained the procedures giving a minimum of exact information and a maximum of reassurance. For example, some patients were apprehensive over the possibilities that they might be shocked in spite of the fact that electric shock treatments have been discontinued in this hospital for several years. Most subjects seemed to accept the explanation that the lead wires were similar to those of an EKG or a measure of pulse in the finger.

While the experimenter secured routine background

information from the subject, the experimental assistant adjusted the bridge to balance the resistance (or conductance) of the subject. Gross changes in the subject were compensated, during the experiment, by further adjustments in order to provide a measurable conductance record throughout. Background information from patients was verified from hospital records. After these preliminaries, the experimental procedures were initiated. These procedures are briefly outlined in Table 3 and are described in detail on the following pages.

1. Initial resting condition (Relax I). Instructions:

> The whole thing will take about an hour and I will tell you each time when there is something for you to do. Get as comfortable as you can to begin with so you can relax and keep still during the whole time. Get comfortable now. OK? Are you in a good comfortable position? Now, just relax but stay awake and when I speak to you again just continue to sit still but listen to what I say. It will be important throughout the whole time that you do not move your position. Now, relax. I will let you relax for a long time, about 15 minutes. We won't talk until later when I tell you. See how relaxed you can get.

During this period conductance levels were the primary measure. The tapes were marked, for later reading, at the beginning and end of the relaxation period. The relaxation period was ended after 8 minutes if the record had stabilized but up to 12 minutes was allowed for some subjects. The

Table 3

Outline of Experimental Sequence

Condition	Time	Stimulus conditions	Responses measured[a]
1. "Relax I"	8-12 min.	Instructions to rest or relax.	C after instructions, C in final 90 sec.
2. "Set-to-Perceive"	6 min.	"Loaded" and "neutral" words at 15 sec. rate while S listens.	C prior to instructions and prior to first word; GSRs for "neutral" and "loaded" words; C preceding last 3 words.
3. "Set-to-Respond"	8-12 min.	"Loaded" and "neutral" words and verbal responses by S, at rate of 15 sec.	C prior to instructions and prior to first word; GSRs for "neutral" and "loaded" words; C preceding last 3 words.
4. "Relax II"	8-12 min.	Instructions to rest or relax.	C in final 90 sec.
5. "Verbal threat"	1/2 min.	Instructions that blood sample will be taken.	GSR in 15 sec.
6. "Touch"	1/2 min.	Take hand, clean finger with cotton and alcohol.	GSR in 15 sec.
7. "Sham pain"	1/2 min.	Sticking motion with lancet, but touch with dull end.	GSR in 15 sec.
8. "Pain"	1/2 min.	Pierce skin with lancet.	GSR in 15 sec.; C 15 sec. after peak GSR.
9. "Relax III"	5 min.	Instructions to relax and that experiment will end.	C in final 90 sec.

[a]C = conductance level; GSR = amplitude of conductance change to a specific stimulus.

following condition was then initiated.

2. Set-to-perceive. Instructions:

> Now, just continue to sit there relaxed, but listen. I am going to say some words, one at a time. I want you to think about what each word means but do not say anything and do not do anything. Just continue to sit comfortably and listen. Try to be as still as you can and still be comfortable. Just listen and think about the words.

The words were presented, after a 15 second pause, at 15 second intervals. Exceptions in the rate of presentation were made if the subject stirred, moved, coughed, etc., in which case the experimenter delayed presenting the next stimulus until the meter stabilized. Just prior to the first three words the experimenter said, "Think about the word _____" following which no further prompting was done. The two forms of the word list were rotated between this and the next condition.

Tapes were marked, for later reading, at the time of instructions and at the presentation of each stimulus word. Thirty seconds after the last word, the following instructions were given.

3. Set-to-respond. Instructions:

> Now, I am going to say some more words. This time I want you to say the first word that comes to your mind as quickly as you can. After I say each word, you say the first word you think of. Just say one word, no matter how silly or unrelated it may seem. All we need

> is one word. Continue to sit still and do not move while we are going through the list. All right, say your word quickly after I have read each word from the list. Just say a single word for each one I read, and say it loudly enough so I can understand what you say.

After an initial 15 second pause, the words were presented approximately 15 seconds after each response to the previous word. In order to help some subjects establish a response habit, in the event the subject did not respond within 20 seconds the experimenter prompted, "What word do you think of when I say _____" following the first three words only.

Tapes were marked, for later reading, at the times of instructions, each stimulus word, and each verbal response. A verbatim record of all audible verbal responses by the subjects was taken by the experimenter. Thirty seconds after the last response the following instructions were given.

4. Intermediate relaxation (Relax II). Instructions:

> That was very good. Now, I want you to relax again. Adjust your position now and get comfortable again. Stretch if you wish. Get in a comfortable position you can keep for the rest of the time. Fine, are you comfortable now? Now, just relax again until I tell you what to do next. Just relax and stay awake.

Tapes were marked, for later reading, at the beginning and end of the instructions and at the end of the relaxation

period. When the record had stabilized, between 8-12 minutes, the next procedure was initiated.

5. Verbal threat of pain. Instructions:

Now we need to take a blood sample from your finger.

After these words, the experimenter turned away to prepare cotton and alcohol swabs, wrote the patient's name on a glass laboratory slide, and secured a blood lancet, all quite conspicuously. During this and the remaining procedures the experimenter watched the meter in order to avoid introducing a new stimulus while the response to the previous one was incomplete. Ordinarily, within 15-20 seconds the conductance level had returned approximately to that before the stimulus.

6. Touch (prepare finger). Instructions:

May I have your hand.

The experimenter took the free hand of the subject and cleaned the middle finger with cotton and alcohol. He continued to hold the hand without releasing it during the next two procedures. When the meter reading had stabilized after cleaning the finger the next procedure was initiated.

7. Sham pain. Instructions:

Now we need to stick your finger.

With these words, the experimenter poised the disposable blood lancet for approximately 2 seconds, then, with a

quick motion, touched the prepared finger of the subject with the dull end. The blade was held in a partly concealed manner so that the subject could not see that the dull end had been used. Tapes were marked when the instructions were given and when the blade touched the finger. The next procedure was initiated when the meter reading had stabilized.

8. Pain. Instructions:

> I didn't get it that time. Let's try again.

The experimenter again poised the blade for 2 seconds, and with a similar motion, pierced the skin of the prepared finger so that a drop of blood formed. After the meter had stabilized a blood sample was taken on the laboratory slide and the finger was again cleansed with cotton and alcohol. The subject's hand was then released for the first time after it had been taken initially (procedure 6 above). Then the last instructions were given. Tapes were marked as in the previous condition.

9. Final relaxation (Relax III). Instructions:

> OK. That was fine. Now just relax again for a while and we will be all through.

After 5 minutes of relaxation the procedures were concluded. The electrodes were removed and the subjects were offered candy and cigarettes. All subjects were thanked for

their cooperation and were asked to maintain silence in respect to the procedures until the study was completed. The control subjects were given a gratuity of $2.00. Inquiry among the last few control subjects revealed that they had heard very little about the exact procedures from previous subjects and at most had learned about the reclining chair and that wires were attached to the fingers. It is probable that communication among the patients was even less, although one patient asked for her piece of candy prematurely.

CHAPTER IV

RESULTS

The tests of hypotheses will follow the order in which they were stated in Chapter II. All analyses are based on three groups of subjects except where otherwise indicated. The groups are: 20 normal control subjects, 20 chronic schizophrenic subjects whose verbal responses were judged to be at least minimally adequate, and 14 chronic schizophrenic subjects whose verbal responses were judged inadequate.

The data and analyses which bear directly on the hypotheses are presented in this chapter. Tests of homogeneity of variances, problems in transformations of data, and supplementary analyses are presented in Appendix C. Data derived in the form of conductance change following word stimuli were transformed into square roots of conductance change in view of the failure of these data to meet the necessary assumptions for analysis of variance. Data expressed as conductance change following threat-pain stimuli required no

transformation. All data expressed as conductance levels contained one deviant case (control subject) at a very high conductance level. Variances were heterogeneous with this case included and were homogeneous with it excluded. However, results of analyses of variance were essentially unaffected when the deviant case was deleted. Exceptions are noted and the alternate analyses are presented in Appendix C. Unless otherwise indicated the following analyses and data are based on the inclusion of all data collected in the experiment.

Levels of Autonomic Activation During Set-to-Perceive and Set-to-Respond

Preparatory sets. To evaluate the effects of preparatory sets conductance levels (mhos x 10^{10}) were read prior to presentation of instructions and 15 seconds after instructions (prior to presentation of stimulus words) for each condition. The hypothesis was:

1. In response to instructions but prior to presentation of stimulus words (in a word association task), chronic schizophrenic subjects will show smaller increases in autonomic activation levels than will normal control subjects.

The group means and standard deviations before and after instructions (and at the end of the word series) are

presented in Table 4 and the trends are depicted in Fig. 1. Tests of homogeneity of variances and supplementary analyses are presented in Appendix C.

Table 4

Means and Standard Deviations of Conductance Levels Before and After Instructions and at End of Set-to-Perceive and Set-to-Respond Conditions

(Mhos x 10^{10})

Group		Set-to-perceive			Set-to-respond		
		Instructions Before	After	End of condition	Instructions Before	After	End of condition
Control (n 20)	Mean	32.75	37.75	33.25	33.95	47.60	38.55
	S. D.	19.4	22.3	19.8	20.4	23.5	20.1
Adequate Schiz. (n 20)	Mean	31.50	35.10	33.30	33.55	38.35	34.10
	S. D.	12.5	13.3	11.2	12.2	13.0	11.5
Inadequate Schiz. (n 14)	Mean	32.50	34.60	32.00	34.10	38.10	32.90
	S. D.	14.9	13.5	15.5	15.3	13.5	16.0

The trends reveal an apparent increase in conductance levels after the instructions in each condition for all groups. It appears also that the normal control subjects increased to a greater extent, particularly in set-to-respond. Overall

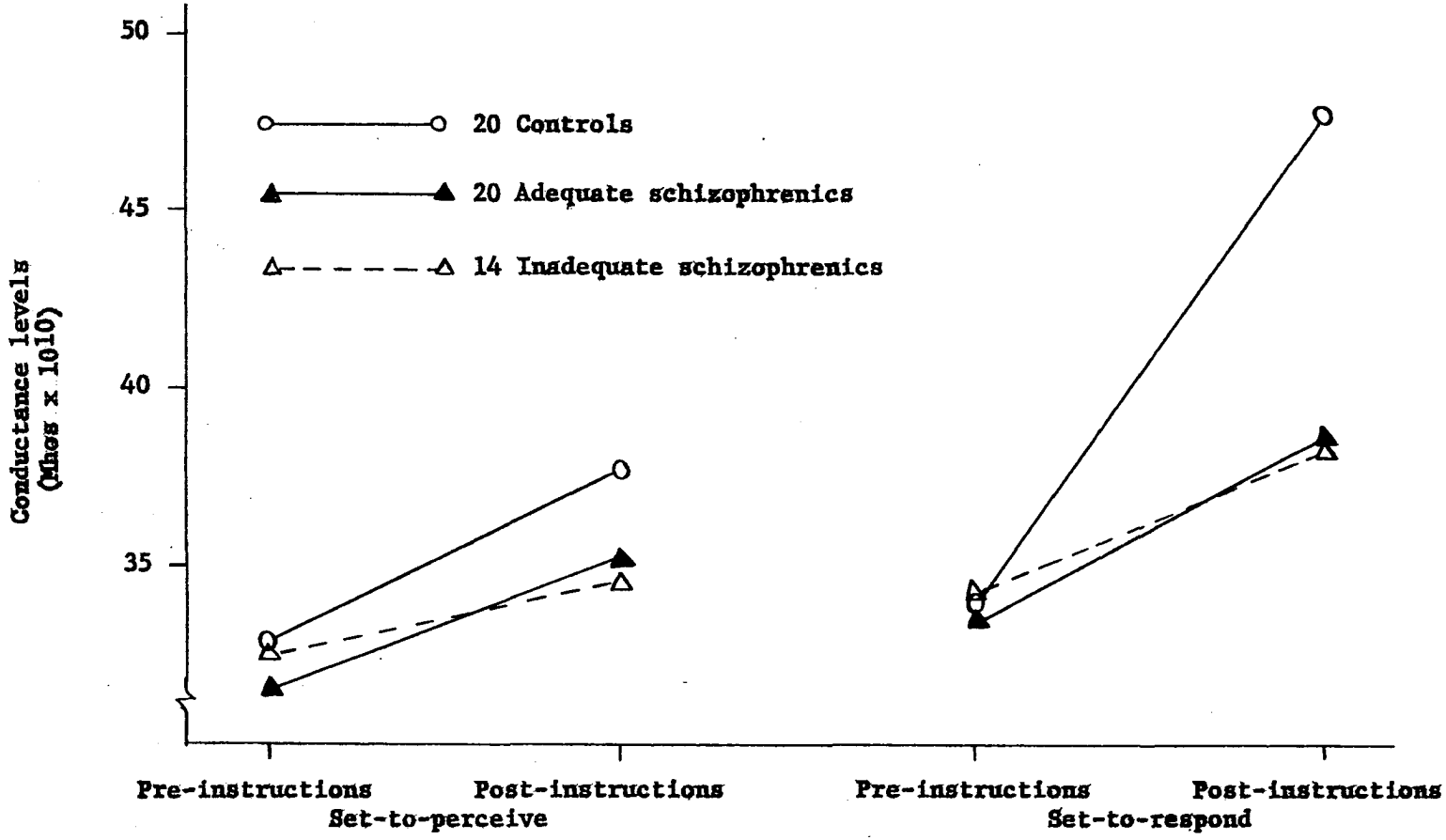

Fig. 1. Preparatory sets: conductance levels before and after instructions for set-to-perceive and set-to-respond conditions for normal control subjects, "adequate" schizophrenic subjects, and "inadequate" schizophrenic subjects.

conductance levels between groups appear to be similar rather than different.

An overall analysis of variance of these data is presented in Table 5. Analyses across time (T) are relevant to this hypothesis. Differences between groups across time (G x T) are greater than expected by chance and are in the predicted direction, confirming the hypothesis that chronic

Table 5

Analysis of Variance I: Conductance Levels Before and After Set Instructions

(Mhos x 10^{10})

Source	d.f.	MS	F	p
Total	215			
Between Subjects	53			
Groups (G)	2	290.5	.28	- -
Error (b)	51	1,043.8		
Within Subjects	162			
Time (T)	1	1,756.0	54.20	.001
Set (S)	1	697.0	21.50	.001
T x S	1	212.0	6.54	.025
G x T	2	212.0	6.54	.005
G x S	2	59.0	1.82	- -
G x S x T	2	89.0	2.75	.10[a]
Error (w)	153	32.4		

[a]This analysis was also computed with the deviant subject deleted. The probability levels were essentially the same except G x S x T was at less than .05. See Appendix C.

schizophrenic subjects show less increase in conductance levels than normal controls in preparation for the conditions.

It is of further interest to examine the possibility that the G x T effect was greater for set-to-respond than for set-to-perceive in view of the trends seen in Fig. 1. This effect is tested by the G x S x T interaction in Table 5, which is only marginally significant ($.10 > p > .05$). However, in a supplementary analysis with the deviant control subject deleted (Appendix C) the common criterion of significance ($p < .05$) was met. This effect was examined further by analysis of the data for set-to-perceive and set-to-respond conditions separately (Tables 6 and 7). It may be seen that group differences across time (G x T) in the set-to-perceive condition (Table 6) are not sufficient to reject the null hypothesis while in the set-to-respond data the same term (G x T) is significant ($p < .005$). It is clear, therefore, that group differences across time are significant only in the set-to-respond data. That these differences are between the normal control group and the schizophrenic groups, rather than between schizophrenic groups may be seen in Fig. 1 and by consulting Table 8, in which the schizophrenic groups were analyzed separately and found not to differ significantly.

These findings may be summarized, in part, in the

Table 6

Analysis of Variance Ia: Conductance Levels Before and After Set-to-Perceive Instructions

(Mhos x 10^{10})

Source	d.f.	MS	F	p
Total	107			
Between Subjects	53			
Groups (G)	2	44.00	.08	- -
Error (b)	51	544.00		
Within Subjects	54			
Time (T)	1	374.00	35.52	.001
G x T	2	17.50	1.66	- -
Error (w)	51	10.53		

statement that all groups appear to shift conductance levels to a fairly equal extent in set-to-perceive but that the normal control subjects show greater shifts than chronic schizophrenic groups in set-to-respond. No apparent differences exist between schizophrenic groups in either condition. Therefore, the hypothesis is supported in respect to set-to-respond and rejected in respect to set-to-perceive, i.e., in response to instructions to respond verbally but prior to presentation of stimulus words, chronic schizophrenic subjects show smaller increases in autonomic activation levels

Table 7

Analysis of Variance Ib: Conductance Levels Before and After Set-to-Respond Instructions

(Mhos x 10^{10})

Source	d.f.	MS	F	p
Total	107			
Between Subjects	53			
Groups (G)	2	306.00	.57	- -
Error (b)	51	538.50		
Within Subjects	54			
Time (T)	1	1,595.00	33.38	.001
G x T	2	282.50	5.91	.005[a]
Error (w)	51	47.78		

[a]This analysis was also computed with the deviant subject deleted. The probabilities were essentially the same except G x T was .01.

than normal controls but the groups do not differ in the set-to-perceive condition, all groups showing similar increases in autonomic activation levels.

It may be noted, in passing, that conductance levels between groups (G) in the overall analysis (Table 5) and in all other analyses (Tables 6-8) failed to attain an F value remotely approaching significance. Therefore, any notion that the other effects could have been attributed to overall

Table 8

Analysis of Variance Ic: Conductance Levels Before and After Set Instructions for "Adequate" and "Inadequate" Schizophrenic Groups

(Mhos x 10^{10})

Source	d.f.	MS	F	p
Total	135			
Between Subjects	33			
Groups (G)	1	3.00	.00	- -
Error (b)	32	648.88		
Within Subjects	102			
Time (T)	1	434.00	17.64	.001
Set (S)	1	205.00	8.33	.01
T x S	1	12.00	.49	- -
G x T	1	7.00	.28	- -
G x S	1	0.00	.00	- -
G x S x T	1	3.00	.12	- -
Error (w)	96	24.60		

differences in conductance levels is rejected.

Maintenance of sets. To evaluate the maintenance of sets, conductance levels were read prior to the presentation of instructions and at the end of the condition (median conductance level just preceding the last 3 words in each series). The hypotheses were:

2. When instructed to attend or listen and think about stimulus words (set-to-perceive but not respond verbally)

during the stimulus series, chronic schizophrenic subjects will show less sustained autonomic activation than will normal control subjects.

3. Compared with control subjects, those chronic schizophrenic subjects who produce minimally adequate verbal responses will do so with a greater increase in levels of activation compared with a previous condition in which responses were not required.

The group means and standard deviations before instructions and at the end of the conditions are presented in Table 4 (with preparatory set data). The trends are presented in Fig. 2. Tests of homogeneity of variances and supplementary analyses are presented in Appendix C.

Hypothesis 2 concerns set-to-perceive only. In Table 9, there were no significant differences between groups across time (G x T), a finding which negates the hypothesis. Hypothesis 3 concerns an interaction across conditions. The trends are opposite to those predicted. The trends for control subjects exceed those of the "adequate" verbal responding schizophrenics in increases of conductance levels during set-to-respond, a finding which negates the second hypothesis also. However, the appropriate analysis of variance (Table 9) failed to indicate any significant differences between groups

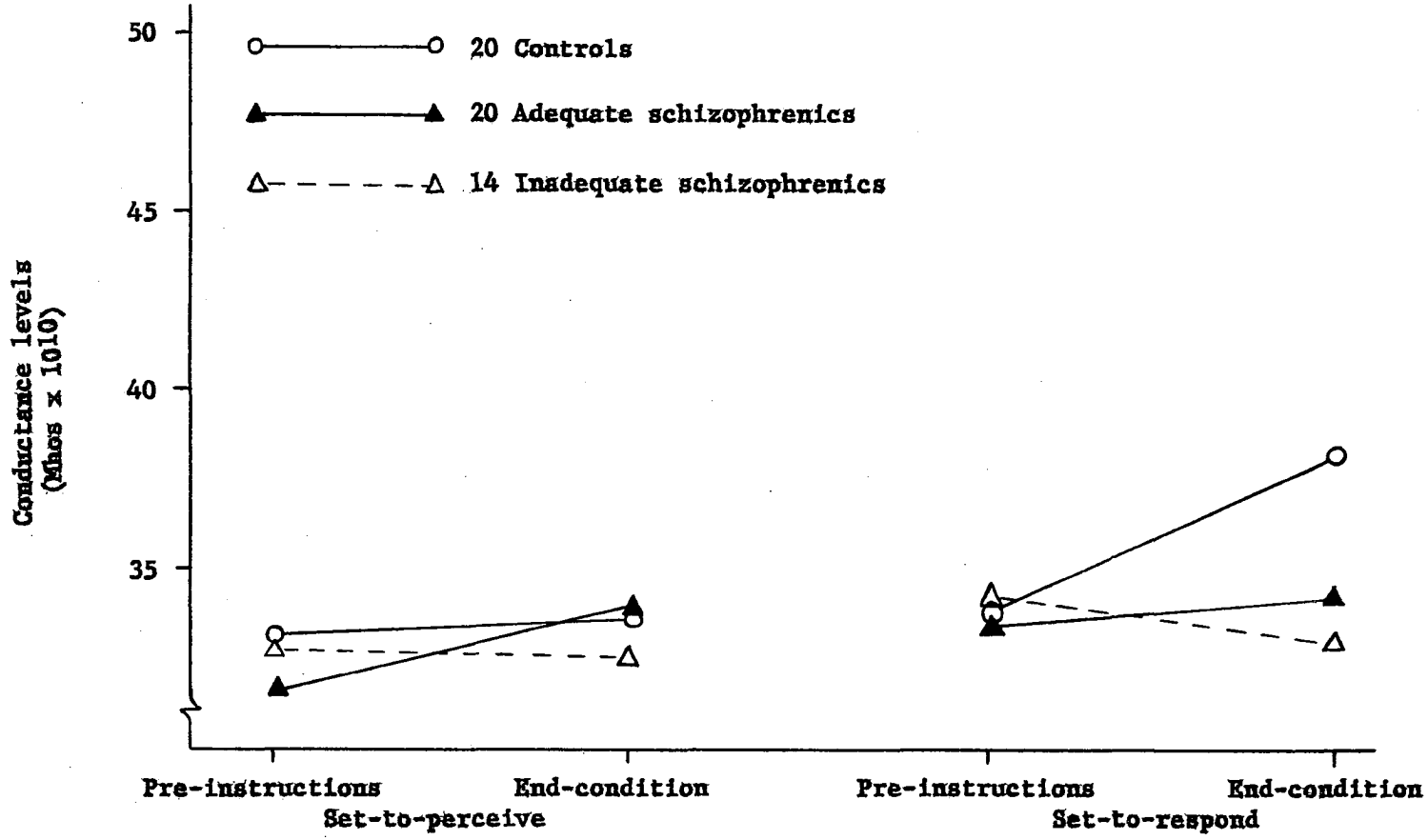

Fig. 2. Maintenance of sets: Conductance levels before instructions and at end of set-to-perceive and set-to-respond conditions for normal control subjects, "adequate" schizophrenic subjects, and "inadequate" schizophrenic subjects.

Table 9

Analysis of Variance II: Conductance Levels Before Instructions and at End of Set Conditions

(Mhos x 10^{10})

Source	d.f.	MS	F	p
Total	215			
Between Subjects	53			
Groups (G)	2	66.00	.06	- -
Error (b)	51	1,014.41		
Within Subjects	162			
Time (T)	1	74.00	3.98	.05
Set (S)	1	228.00	12.25	.001
T x S	1	11.00	.59	- -
G x T	2	46.50	2.50	- -
G x S	2	23.00	1.24	- -
G x S x T	2	41.00	2.20	- -
Error (w)	153	18.61		

Note: This analysis was also computed with the deviant subject deleted. The G x S x T interaction probability level was less than .10. However, separate tests of set-to-perceive and set-to-respond data failed to reveal any significant differences between groups.

despite the trends seen in Fig. 2 which suggest greater gains for the control group during the set-to-respond condition.

Effect of Set-to-Perceive and Set-to-Respond on Specific Autonomic Responses to "Loaded" and "Neutral" Words

To evaluate the effects of sets on GSRs to words, the galvanic responses were measured as change in mhos x 10^{10}

within 15 seconds of each stimulus word or response to the word. The values for each individual were the mean amplitude for the 6 "loaded" words and for the 6 "neutral" words which just preceded the loaded words. Tests of homogeneity of variances and supplementary analyses are presented in Appendix C. The cell variances were heterogeneous when the data were expressed in units of change in mhos x 10^{10} and several transformations were tried. The square root transformation was adopted as providing the most satisfactory approximation to normality, homogeneity of variances, and independence of means and variances, although the criteria were only marginally satisfied. The hypothesis was:

4. Compared with normal control subjects, those chronic schizophrenic subjects who give minimally adequate verbal responses will respond with greater amplitudes of autonomic responses to "loaded" compared with "neutral" words in the set-to-respond series than in the previous set-to-perceive (no-response) series.

The group means, expressed in units of 100 x the square root of mhos x 10^{10} change are presented in Table 10. The trends are depicted in Fig. 3. This hypothesis is concerned primarily with differential responses to loaded and neutral words or as the relative differences in slopes for the groups

Table 10

Means and Standard Deviations of GSRs to "Loaded" and "Neutral" Words in Set-to-Perceive and Set-to-Respond Conditions

(Units are $100\sqrt{\text{Mhos} \times 10^{10}}$ change)

Group		Set-to-perceive		Set-to-respond	
		Neutral	Loaded	Neutral	Loaded
Control (n 20)	Mean	8.53	12.25	20.65	26.77
	S. D.	6.1	7.5	7.9	9.6
Adequate Schiz. (n 20)	Mean	11.81	12.00	16.13	20.94
	S. D.	5.9	6.2	7.2	9.5
Inadequate Schiz. (n 14)	Mean	11.75	9.91	10.14	13.50
	S. D.	7.3	6.9	7.1	10.6

across conditions. It may be noted in Fig. 3 that while the control group slopes appear similar for both conditions, indicating greater GSRs to "loaded" words in each condition, the same is not true of the schizophrenic groups. In the schizophrenic groups a difference favoring greater GSRs to "loaded" words is apparent only in the set-to-respond condition. The slopes for the three groups in the set-to-respond condition appear to be parallel but at different levels. Thus, inspection of Fig. 3 indicates that a second order

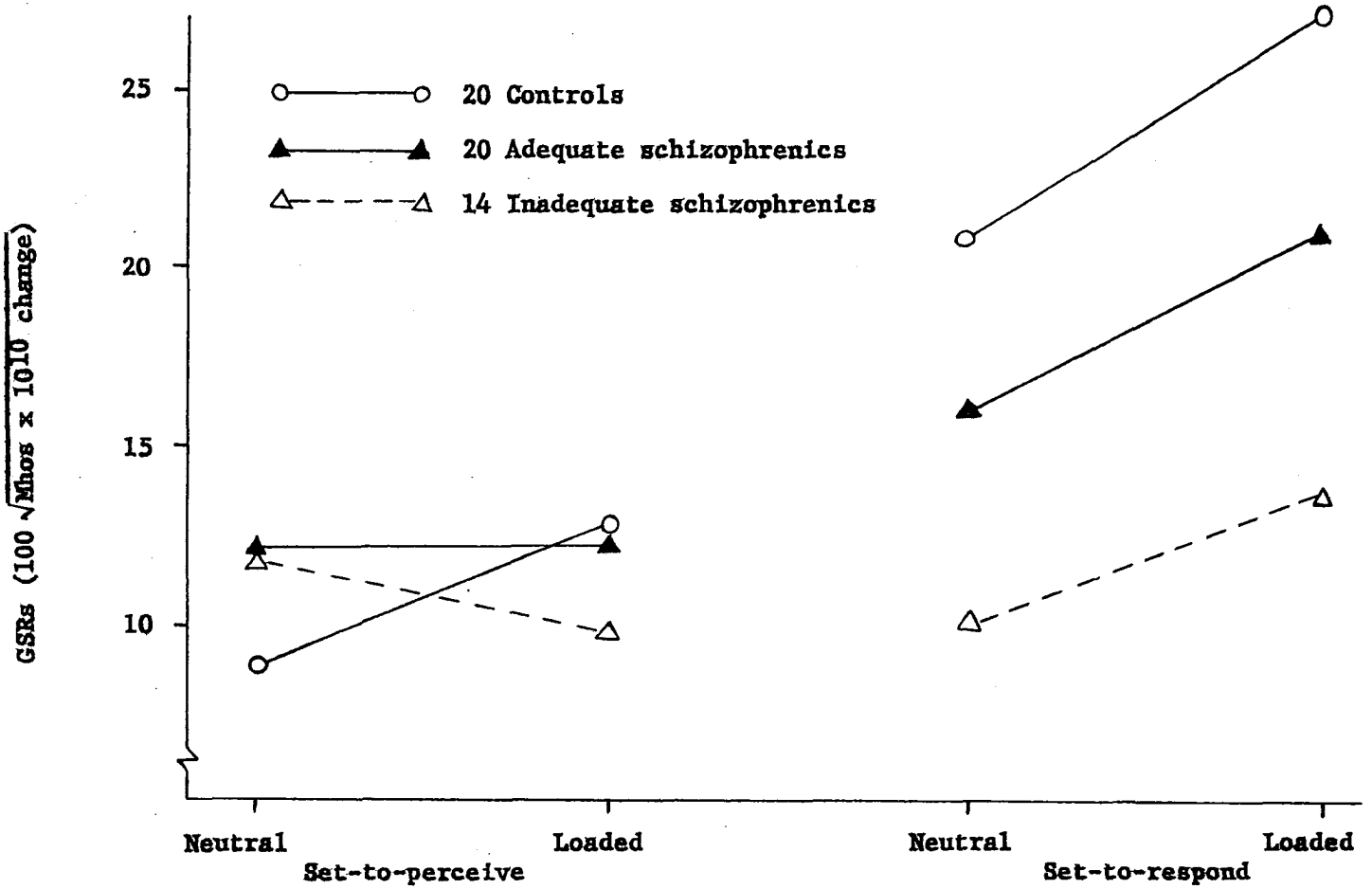

Fig. 3. GSRs to "neutral" and "loaded" words during set-to-perceive and set-to-respond conditions for normal control subjects, "adequate" schizophrenic subjects, and "inadequate" schizophrenic subjects.

interaction may obtain. However, the interaction between groups by word class and conditions (G x W x S) is not significant when all groups are included (Table 11) nor when the control group and the "adequate" schizophrenic group are compared (Table 12).

Table 11

Analysis of Variance III: GSRs to "Loaded" and "Neutral" Words in Set-to-Perceive and Set-to-Respond Conditions

(Units are $100\sqrt{\text{Mhos} \times 10^{10} \text{ change}}$)

Source	d.f.	MS	F	p
Total	215			
Between Subjects	53			
Groups (G)	2	546.74	4.73	.025
Error (b)	51	115.50		
Within Subjects	162			
Set (S)	1	3,154.87	76.48	.001
Words (W)	1	469.09	11.37	.001
S x W	1	210.23	5.10	.025
G x S	2	642.83	15.58	.001
G x W	2	74.25	1.80	- -
G x W x S	2	9.86	.24	- -
Error (w)	153	41.25		

There remains the possibility, although the cell variances were homogeneous according to the Bartlett's test (Appendix C), that the means and variances were sufficiently

Table 12

Analysis of Variance IIIa: GSRs to "Loaded" and "Neutral" Words in Set-to-Perceive and Set-to-Respond Conditions for Control Group vs. "Adequate" Schizophrenic Group

(Units are 100 $\sqrt{\text{Mhos} \times 10^{10} \text{ change}}$)

Source	d.f.	MS	F	p
Total	159			
Between Subjects	39			
Groups (G)	1	134.51	1.33	- -
Error (b)	38	101.11		
Within Subjects	120			
Set (S)	1	3,979.03	92.17	.001
Words (W)	1	550.94	12.76	.001
S x W	1	123.02	2.85	.10
G x S	1	447.89	10.38	.005
G x W	1	58.44	1.35	- -
G x W x S	1	12.27	.28	- -
Error (w)	114	43.17		

related to distort the analysis of this term. It was deemed advisable to consider the set-to-perceive and set-to-respond data separately to determine if a groups by word class interaction (G x W) might be present in one of the conditions and not the other. The set-to-perceive data were analyzed (Table 13), which revealed a significant (G x W) interaction with all 3 groups included.

Table 13

Analysis of Variance IIIb: GSRs to "Loaded" and "Neutral" Words During Set-to-Perceive Condition

(Units are $100\sqrt{\text{Mhos} \times 10^{10} \text{ change}}$)

Source	d.f.	MS	F	p
Total	107			
Between Subjects	53			
Groups (G)	2	23.90	.36	- -
Error (b)	51	66.17		
Within Subjects	54			
Words (W)	1	25.62	1.19	- -
G x W	2	68.37	3.19	.05
Error (w)	51	21.46		

Hypothesis 4 was tested directly by an analysis between just the control group and the "adequate" schizophrenic group. A significant interaction between groups and word class (G x W) is found (Table 14). Since the "inadequate" schizophrenic group is even more divergent from the control group, it may be inferred that the effect obtains between the control group and each of the schizophrenic groups. Thus, in the set-to-perceive condition the control group shows a greater increase in GSR response from "neutral" to "loaded" words than either schizophrenic group. Looking at Fig. 3,

Table 14

Analysis of Variance IIIc: GSRs to "Loaded" and "Neutral" Words During Set-to-Perceive Condition for Control Group vs. "Adequate" Schizophrenic Group

(Units are $100\sqrt{\text{Mhos} \times 10^{10}}$ change)

Source	d.f.	MS	F	p
Total	79			
Between Subjects	39			
Groups (G)	1	45.75	.67	- -
Error (b)	38	68.44		
Within Subjects	40			
Words (W)	1	76.63	5.22	.05
G x W	1	62.13	4.23	.05
Error (w)	38	14.69		

it may be said that the control subjects give greater GSRs to loaded words while the schizophrenic groups do not.

Thus, while the overall analysis (Table 11) did not reflect a significant second order interaction (G x W x S), a first order interaction (G x W) was found in the set-to-perceive data only (Table 14). The same effect does not obtain in the set-to-respond condition (Table 15).

Thus, the hypothesis is not supported by the overall analysis but is supported if the conditions are analyzed separately. The schizophrenic groups give greater GSRs to

Table 15

Analysis of Variance IIId: GSRs to "Loaded" and "Neutral" Words During Set-to-Respond Condition

(Units are $100\sqrt{\text{Mhos} \times 10^{10}}$ change)

Source	d.f.	MS	F	p
Total	107			
Between Subjects	53			
Groups (G)	2	1,165.67	8.71	.001
Error (b)	51	133.90		
Within Subjects	54			
Words (W)	1	653.66	36.46	.001
G x W	2	15.74	.88	- -
Error (w)	51	17.93		

"loaded" than to "neutral" words in set-to-respond but not during set-to-perceive, contrasted with the control group which responded more to "loaded" words in both conditions.

An additional finding in these data is that overall GSRs during set-to-respond are significantly different between groups (Table 15) while during set-to-perceive there were no significant differences between groups in GSR level (Table 13). The effect is also apparent in the G x S interaction of the overall analysis (Table 11). It may be seen in Fig. 3 that in set-to-respond control subjects give the

greatest GSRs, followed by "adequate" verbal responding schizophrenics, then by "inadequate" verbal responding schizophrenics. It may be seen, in addition, that the increase is greater between set-to-perceive and set-to-respond in the control group (Fig. 3) and that the interaction is significant (G x S) in Table 12.

Specific Autonomic Responses to the Threat-Pain Stimuli

To evaluate GSRs to the various stimuli in the threat-pain series, galvanic responses were measured in onductance change units (change in mhos x 10^{10}) from the point just before the stimulus was presented to the point of highest amplitude within 15 seconds. The hypothesis was:

5. Compared with normal control subjects, chronic schizophrenic subjects will be less responsive autonomically to all threat-pain stimuli except the physical pain stimulus.

The group means and standard deviations are presented in Table 16. Tests of homogeneity of variances are presented in Appendix C. The analysis of variance of these data is presented in Table 17. Despite the fact that all subjects gave GSRs of considerable magnitude in comparison with the amplitudes in the word series, no significant differences

Table 16

Means and Standard Deviations of GSRs to Threat-Pain Stimuli

(Units are Mhos x 10^{10} change)

Group		Verbal threat	Prepare finger	Sham pain	Physical pain
Control (n 20)	Mean	26.35	21.45	23.90	23.00
	S. D.	20.3	15.4	13.6	13.6
Adequate Schiz. (n 20)	Mean	15.30	22.15	21.75	21.70
	S. D.	17.3	16.3	13.1	14.1
Inadequate Schiz. (n 14)	Mean	21.21	20.85	15.86	20.86
	S. D.	14.6	12.3	9.9	10.2

between groups were found in the threat-pain series, due partly to increased within groups variation. The groups by conditions interaction (G x C) failed to exceed chance and there were no significant differences between conditions (C).

Therefore, with the exception that group differences were found in responses to "loaded" vs. "neutral" words in the set-to-perceive condition (previously described), it cannot be said that the chronic schizophrenic subjects were any less responsive to stimuli than the control subjects. With this qualification, the hypothesis is rejected.

Table 17

Analysis of Variance IV: GSRs to Threat-Pain Stimuli

(Units are Mhos x 10^{10} change)

Source	d.f.	MS	F	p
Total	215			
Between Subjects	53			
Groups (G)	2	262.5	.53	- -
Error (b)	51	497.1		
Within Subjects	162			
Conditions (C)	3	13.0	.10	- -
G x C	6	216.8	1.72	- -
Error (w)	153	126.1		

Overall Levels of Autonomic Activation

In order to test hypotheses concerning overall levels of autonomic activation, conductance levels were read (mhos x 10^{10}) at each of seven points in the experiment: initial level just following instructions to relax, at the end of Relax I, end of set-to-perceive, end of set-to-respond, end of Relax II, 15 seconds after peak response to the pain stimulus, and at the end of Relax III. The hypothesis was:

6. Compared with normal control subjects, chronic schizophrenic subjects will show lower levels of autonomic activation throughout the experiment.

The group means and standard deviations are presented in Table 18 and the trends are presented in Fig. 4. Tests of homogeneity of variances and supplementary analyses are presented in Appendix C. The overall analysis of variance is presented in Table 19. Group differences were not in the predicted direction, nor were they significantly different. The hypothesis is rejected.

It may be noted that in all the previous analyses concerned with conductance levels, no group differences were found except for changes due to shifts of set. Although the point was introduced earlier, it may be said again that any significant effects found in GSRs to specific stimuli cannot be attributed to a relationship of GSRs to conductance levels since differences in conductance levels between groups fail to be demonstrated.

Summary

All hypotheses were tested by appropriate analyses of variance with the following results:

1. In response to instructions but prior to presentation of stimulus words (in a word association task), chronic schizophrenic subjects will show smaller increases in autonomic activation levels than will normal control subjects.

Table 18

Means and Standard Deviations of Conductance Levels Throughout the Experiment: Initial, Relax I, End Set-to-Perceive, End Set-to-Respond, Relax II, 15 Seconds After Pain Reaction, and Relax III

(Units are Mhos x 10^{10})

Group		Initial	Relax I	End perc.	End resp.	Relax II	Pain plus 15"	Relax III
Control (n 20)	Mean	37.60	33.00	33.25	38.55	33.20	42.50	32.40
	S. D.	16.6	19.2	19.9	20.2	17.2	19.7	17.3
Adequate Schiz. (n 20)	Mean	37.05	32.10	33.30	34.10	31.20	41.50	29.25
	S. D.	13.4	13.1	13.3	11.6	11.6	11.5	10.4
Inadequate Schiz. (n 14)	Mean	41.64	33.29	32.00	32.93	32.21	44.14	30.57
	S. D.	11.8	14.3	15.5	16.0	13.3	9.8	12.6

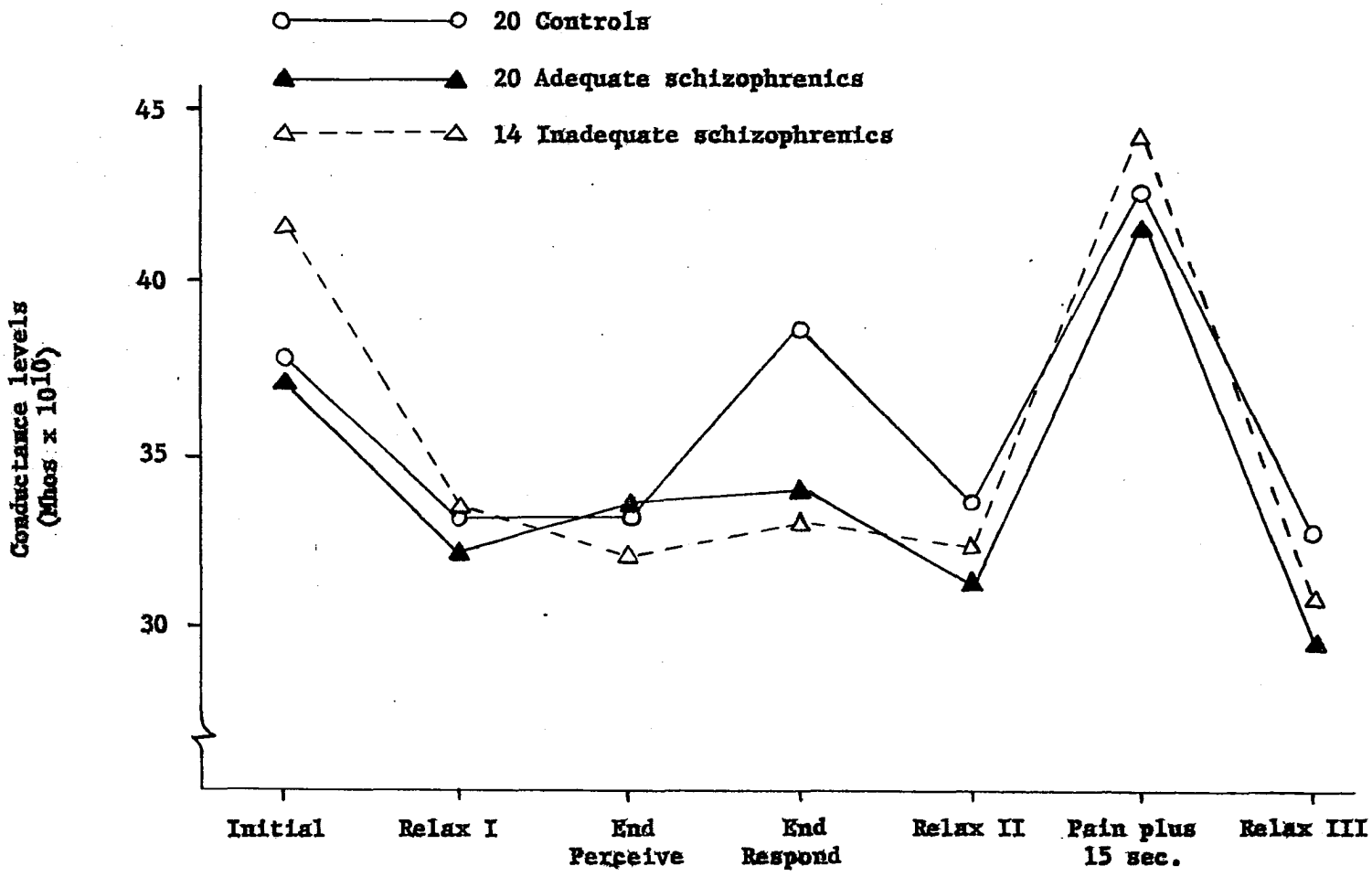

Fig. 4. Conductance levels throughout the experiment: initial, Relax I, end set-to-perceive, end set-to-respond, Relax II, 15 seconds after pain reaction, and Relax III for normal control subjects, "adequate" schizophrenic subjects, and "inadequate" schizophrenic subjects.

Table 19

Analysis of Variance V: Conductance Levels Throughout the Experiment: Initial, Relax I, End Set-to-Perceive, End Set-to-Respond, Relax II, 15 Seconds After Pain Reaction, and Relax III

(Units are Mhos x 10^{10})

Source	d.f.	MS	F	p
Total	377			
Between Subjects	53			
Groups (G)	2	106.00	.08	- -
Error (b)	51	1,393.00		
Within Subjects	324			
Conditions (C)	6	938.50	23.12	.001
G x C	12	44.08	1.08	- -
Error (w)	306	40.59		

Note: This analysis was repeated with the deviant control subject deleted. The probability levels were identical with this analysis.

The hypothesis is confirmed but the differential increases of the control group are found during set-to-respond only. All groups increased in conductance levels to an approximately equal degree during set-to-perceive.

2. When instructed to attend or listen and think about stimulus words (set-to-perceive but not respond verbally) during the stimulus series, chronic schizophrenic subjects will show less sustained autonomic arousal than will control

subjects.

The hypothesis is rejected.

3. Compared with normal control subjects, those chronic schizophrenic subjects who produce minimally adequate verbal responses will do so with a greater increase in levels of activation compared with a previous condition in which responses were not required.

The hypothesis is rejected.

4. Compared with normal control subjects, those chronic schizophrenic subjects who give minimally adequate verbal responses will respond with greater amplitudes of autonomic responses to "loaded" compared with "neutral" words in the set-to-respond series than in the previous set-to-perceive (no-response) series.

The hypothesis is confirmed. In the set-to-perceive series, the control group gave significantly greater differential GSRs to "loaded" words than did the chronic schizophrenic groups but in the set-to-respond series all groups gave approximately equal differential GSRs to "loaded" vs. "neutral" words.

5. Compared with normal control subjects, chronic schizophrenic subjects will be less responsive autonomically to all threat-pain stimuli except the physical pain stimulus.

The hypothesis is rejected; no significant differences between groups are found in GSRs to specific stimuli except as differential responses to word class during set-to-perceive (hypothesis 4 above).

6. Compared with normal control subjects, chronic schizophrenic subjects will show lower levels of autonomic activation throughout the experiment.

The hypothesis is rejected; no significant differences are found.

CHAPTER V

DISCUSSION

In this experiment it was found that chronic schizophrenic subjects are not significantly different from normal control subjects in several important respects. On-going levels of autonomic activation (skin conductance levels) provided no evidence that chronic schizophrenic subjects are apathetic or lethargic, their conductance levels being essentially the same as normal control subjects. Further, specific autonomic reactions (GSRs) to fairly direct threat of pain and pain producing stimuli are essentially of the same magnitude as control subjects, which leads to the rejection of hypotheses that chronic schizophrenic subjects are detached or emotionally withdrawn from these stimuli.

Differences between groups appeared primarily in GSR amplitudes to more subtle conceptual stimuli during set-to-perceive, in shifts of conductance levels while establishing sets to respond, and in GSR amplitudes while giving overt

verbal responses.

These findings and various methodological considerations are discussed in the following paragraphs.

Subjects

It seems reasonable to assume that the chronic schizophrenic sample is free of bias since it was selected from the hospital population by a table of random numbers. Rosenthal et al. (1960) have recognized that sampling bias often occurs, sometimes unwittingly, by the selection of only those patients who can perform a complex experimental task or who meet some criterion of cooperativeness. Often, the tendency is to use only those subjects who fit the psychological techniques rather than to find techniques which fit the subjects. These considerations are critical in the study of chronic schizophrenia. A serious attempt has been made to avoid this source of bias in the present experiment, although, as was mentioned, 2 of 36 chronic schizophrenic subjects who were selected at random were unable to participate.

Another extraneous factor which may seriously influence experimental findings with psychiatric patients is that of concurrent individual therapies. Electric shock treatments as well as chemotherapies can and do have drastic effects on

the psychological functioning of these patients and the effects may carry over for weeks or months. Effects of somatic treatments are not always positive and a wide range of individual differences due to the treatments rather than to the mental illness of the patients can distort their performance on an experimental task. Since the patients who appeared in the present experiment were free of these somatic therapies for more than a year prior to the experiment, it is believed that their performance was more a function of chronic schizophrenia, as opposed to concurrent treatment effects, than any other group in the recent literature. It must be recognized, however, that these patients had been confined an average of 16.4 years in the mental hospital prior to the experiment, a factor which undoubtedly has effects in its own right. Yet, this is where chronic schizophrenia is found, and to this extent the sample is typical.

The patients are classical examples of chronic schizophrenia who manifest the full spectrum of clinical symptoms. Typical of the descriptive comments found in the notes of the ward psychiatrist are those given for the following 5 patients:

> The patient wandered aimlessly on the ward. She giggled continuously without apparent reason, her speech was incoherent, and she expressed herself only in

disconnected sentences.

> This patient presented exuberant symptomatology consisting of delusional ideas and hallucinations. She asserted that she had been born a male but was castrated early in life. She supposedly saw Jesus Christ's dead body and the faces of white men turning black.
>
> She spoke in a rambling way about an atomic force which blew her body to pieces, someone putting the pieces back together, and the idea that her body belonged to someone else in the past.
>
> This woman claimed to be able to see Jesus Christ and supposedly earned $60,000 a month. She said she could destroy people by just talking to them and came to the hospital because "there was a strike on the land. It was like a wave. It went through you and if other people talked it would shoot like an explosion."
>
> This woman walked around on the ward with her dress pulled between her legs acting as if she were modeling bathing suits. She decorated herself with bizarre necklaces and bright scarfs and even painted her vagina with lipstick. She claimed to live in Germany rather than in a psychiatric hospital.

In addition to the rich variety of ideational symptoms, the group included mute and inactive patients as well as those who would scream and fight. In one manner or another, the group showed the profound disruption of psychological processes characteristic of chronic schizophrenic women after prolonged duration of the condition and they expressed their symptoms somewhat more freely, perhaps, than would have been the case had they been under medication or the continuous threat of electric shock treatment.

Since the results of the present experiment are strikingly different in several respects from those of some previous research reports, it is possible that several factors, in addition to those mentioned above, may account for the differences. In the present study, the experimenter had been closely associated with the subjects for 3 years prior to the study. Thus, rapport was a pre-existing condition in most cases. Further, the use of the overstuffed reclining chair seemed to induce psychological as well as physical comfort. In the chair, many patients gave verbally coherent responses when, on the basis of contacts on the ward, the experimenter had not expected them to do so.

Psychiatric aides (ward attendants) were used as control subjects. They were preferred over the professional nursing personnel since, in this hospital, aides more closely resemble patients in age, education, locale of residence, cultural background, and socio-economic status. Judging by their everyday effectiveness and their word association responses, it seems safe to assume that they were not schizophrenic and that they form a fairly adequate basis for contrast with the schizophrenic group.

On-going Levels of Activation

The results fail to support the hypothesis that levels of autonomic activation across the whole experiment would be less in chronic schizophrenic subjects. The only aspect of the experiment where group differences in conductance levels appear is during preparations to respond. Before and after the preparations to respond the group conductance levels are quite similar.

Had there been a significant difference between chronic schizophrenic and control groups in conductance levels, it would have been interpreted as either apathy and lethargy or tension and anxiety, etc., depending on the direction of the differences. Since no significant difference is found, a problem arises. Is it possible to conclude that chronic schizophrenic and normal subjects function at a similar emotional level? Another statement concerning the relation between emotion and galvanic skin response may be helpful in clarifying this question:

> We raised the question as to whether or not the GSR measured emotion and suggested that it was a poor question. All we have written since then confirms the judgement. Yet a vast amount of paper, not to mention much good research time, has been wasted in an attempt to answer the question. Around 1930 a symposium on GSR was held at a meeting of psychologists. After a half dozen people had argued that the GSR was not a good

> measure of emotion, Wechsler pointed out that the trouble was with the concept of emotion, rather than with GSR. We should stop thinking of Emotion with a capital E, as a special mental or behavioral state; this type of thinking is a heritage from the prescientific trilogy of Cognition, Volition, and Affection. Instead, we should use emotion to describe the individual who is highly energized, active, tense, or activated. For emotion in this sense, both basic level of conductance and the GSR become pretty good measures, since they reflect various degrees of activation, of readiness for action, ranging from sleep to rage (Woodworth & Schlosberg, 1958, p. 159).

and,

> The absolute level of conductance has received less attention than it deserves. It seems to be a good measure of the general level of activation, for conductance is high when O is alert and low when he is relaxed (Woodworth & Schlosberg, 1958, p. 137).

Whether conductance level is used as an index of emotion (with a small e) or simply as an index of tension or relaxation, the psychological implications cannot be doubted. Knowing the tension state via conductance level, however, is not the same as knowing its specific referent in the emotional sphere, i.e., whether fear or anger, apathy or tranquility, etc. It is not possible, for example, on the basis of conductance level alone, to conclude that our chronic schizophrenic and normal control subjects are in a state of equal "readiness for action" simply because their conductance levels do not differ. The same tension level, in the quantitative sense, may have entirely different psychological

meaning, a matter which may be sifted out best by systematic experimental variation in specific experiments.

Even so, in this experiment it has been disconcerting if not astonishing to find that chronic schizophrenics, who suffer from a psychological condition thought to be basically an emotional disturbance by many, are not different from normals in tension level. The notion that some chronic schizophrenic subjects were excessively low while others were excessively high can be rejected. The variances in the data for the chronic schizophrenics are homogeneous with those in the control group.

It is possible, of course, that disturbances in conductance level may occur during the onset of schizophrenia but that an equilibrating or homeostatic process has permitted the chronic schizophrenic to arrive again at a biologically optimum level of activation. A similar observation has been made in reference to research on "process" and "reactive" groups by G. F. King. Citing data on blood pressure reactivity to mecholyl for both normals and schizophrenics, he said,

> The reactives [acutes] would be high in autonomic responsiveness, whereas the normals and process [chronic] patients would be relatively low. Such a relationship offers a more adequate account of studies

> which have found that schizophrenics, especially patients in the early stages of illness, are physiologically even more reactive than normals. . . . Early schizophrenics were hyper-reactive on cardiovascular measures; if the illness persisted, however, the same Ss dropped toward or even below the normal level. . . . A possible explanation lies in viewing both normals and process schizophrenics as representing relatively uniform, stable adjustments over a period of time. It is suggested that the corresponding physiological homeostasis is indicated by a low autonomic responsiveness. A heightened autonomic reactivity then would reflect a disruption of homeostasis, which corresponds with the more transient, precipitous nature of the reactive adjustment (1958, p. 163).

While in the above quotation G. F. King is using the terms "process" and "reactive," for the present purposes the terms "chronic" and "acute" seem equally appropriate. The notion that schizophrenia is a way of solving anxiety rather than being a perpetual state of anxiety (Arieti, 1955) seems congruent with these findings.

However, the data showing near equivalence between chronic schizophrenics and normals in levels of autonomic activation cast serious doubt on the validity of some common terms in the parlance of mental hospitals such as the "burned out" chronic schizophrenic or even the notion of "vegetative existence," in so far as these terms imply an inferior level of autonomic functioning.

The finding of equivalent levels of conductance for chronic schizophrenic and normal subjects also seems in

direct contrast to the findings of Howe (1958). From his results it was expected that chronic schizophrenic subjects would have higher skin resistance (low conductance) levels than normal subjects and that the inadequate verbal responders would deviate to an even greater extent. Nevertheless, all three groups of subjects in the present experiment were at essentially equivalent conductance levels. It is possible that the differences seen in the Howe study were due to differential treatments rather than chronicity or apparent deterioration.

In the present study, then, chronic schizophrenia is not associated with a disturbance in on-going levels of autonomic activation. In keeping with the discussion of Silverman et al. (1959, p. 68), these subjects are not at a level of arousal so low as to produce lack of attention or lack of reactivity, nor are they at a level of arousal so high as to indicate hyperactivity or disruption by excessive internal activity in the central nervous system. Rather, from the point of view of level of activation, they are in a range at which vigilance or alertness to stimuli may occur.

Autonomic Reactivity to Threat-Pain Stimuli

The results also fail to support the hypothesis that chronic schizophrenic subjects are autonomically less reactive

than normal control subjects to threats of pain, sham-pain, and pain stimuli. These data are consistent with the conclusions of Malmo et al. (1951), i.e., that those aspects of responsiveness associated with emotional arousal seem intact. The chronic schizophrenic subjects in this experiment gave no evidence of diminished autonomic reactions to threat-pain stimuli.

The finding that chronic schizophrenic subjects are autonomically as responsive as normals to the statement that a blood sample would be taken, since it is clearly not an unconditioned stimulus, also refutes the hypothesis that autonomic reactions in the threat-pain series were merely a matter of unconditioned responses. Since affective (autonomic) reactions occurred to conceptually presented threat of pain and sham-pain even before pain was introduced, it is assumed that both perception and intellectual discrimination also occurred. Under these conditions, then, it would seem that the perceptual process is intact, that the intervening intellectual analysis or understanding is intact, and that the affective (autonomic) processes are intact.

The preceding discussion does not include all of the facts, however, since it has been based on reactions to the threat-pain stimulus series only. It is also necessary to

consider GSRs to "neutral" and "loaded" words, which adds to the complexity of the problem but which permits the identification of an area of functioning in which chronic schizophrenics differ from normal subjects.

Autonomic Reactivity to "Loaded" and "Neutral" Words

GSRs to "loaded" and "neutral" words, during set-to-perceive, and GSRs to the threat-pain stimuli were obtained under similar circumstances since overt verbal responses were not given in either condition. On the other hand, the set-to-respond condition is different since these GSRs also include galvanic reactions to the verbal responses as well as to the stimuli.

Control subjects gave greater GSRs to "loaded" vs. "neutral" words in both set-to-perceive and set-to-respond. The chronic schizophrenic groups failed to give greater GSRs to "loaded" words during set-to-perceive, but, during set-to-respond they gave greater GSRs to "loaded" vs. "neutral" words in essentially the same magnitudes of difference as the normal control subjects.

It is interesting to note that even the "inadequate" verbal responding schizophrenic group gave differential GSRs

to "loaded" words during set-to-respond despite the fact that 8 subjects in this group were mute during the word series. This finding seems generally consistent with the incidental learning studies (Winer, 1954; Greenberg, 1954) which indicated that chronic schizophrenics could be induced to attend sufficiently to learn material to which their attention had been directed while failing to learn material which was incidentally presented. In the present experiment it seems that the set-to-respond instructions served to orient the subjects to the nature of the material or caused them to become involved in the material to a greater degree than in the previous set-to-perceive condition.

Since it was in the set-to-perceive condition that chronic schizophrenic subjects failed to give differential autonomic responses to word classes, it will be useful to consider the implications in detail. It seems reasonable to assume that the "loaded" words do not carry with them any immediate situational threat and that the "emotional" (GSR) reactions are a function of symbolic elaboration on the part of the subject. As was mentioned in the earlier discussion of the findings of Malmo et al. (1951) and Williams (1953) it may be that anxiety is elicited from within the subject on the basis of his own fantasies. Whether the further

symbolic elaboration and the accompanying GSR is primarily a function of the social situation, due to the presence of the experimenter, or would occur in the absence of the experimenter is not known but could be tested experimentally. However, for normals, the differences between GSRs to "loaded" vs. "neutral" words did not increase when the response instructions were added. The added social confrontation did not seem to increase the differential emotional import of the "loaded" words for the normal subjects.

A difficult and intricate interpretive problem is presented when all the findings concerning reactions to specific stimuli are considered simultaneously. In the introduction to this dissertation a statement was made "that a hierarchy of stimuli may be involved and that chronic schizophrenic patients, compared with control subjects, will be less responsive or more withdrawn in respect to conceptual, emotionally toned, psychological stimuli, but will be relatively less detached in respect to threat of pain and pain stimuli" p. 30). The outcome is consistent with that formulation. In the absence of instructions to respond verbally, the chronic schizophrenic subjects responded to pain and threat of pain but seemed relatively detached in respect to emotionally toned conceptual stimuli. The Malmo et al. (1951) and

Williams (1953) studies now seem complementary rather than contradictory. In one experiment (Malmo et al., 1951) autonomic responses of schizophrenics to pain stimuli were equivalent to normals while in the other (Williams, 1953) autonomic reactions to conceptual emotionally toned materials were diminished in chronic schizophrenics compared with normals.

Support for the position that changes in the psychological state of chronic schizophrenic subjects can be induced which will increase autonomic reactions to conceptual stimuli is also found. GSRs to "loaded" vs. "neutral" words were increased by the response set instructions in the chronic schizophrenic group.

It is interesting to note that these findings are, in some respects, a reversal of the controversial "perceptual defense" problem. The question posed in respect to that data was, to paraphrase the authors, "If the subject does not perceive, how does he know when to react?" (Eriksen & Brown, 1956; McGinnies, 1949; Postman, Bruner, & McGinnies, 1948). Conversely, the problem posed by the present situation is "If the subject perceives, why doesn't he react?" In perceptual defense the subjects react affectively (McGinnies, 1949) presumably without perceiving consciously. In the

present situation the subjects presumably perceive without reacting affectively. It is tempting, mischievously, to coin the term "emotional defense" for the situation in which chronic schizophrenic subjects failed to react differentially to the "loaded" and "neutral" words.

In any event, the present evidence would seem to indicate that in all situations (set-to-perceive, set-to-respond, verbal threat of pain, etc.) perception ("awareness") of word meanings was not defective. However, under conditions where overt voluntary (verbal) responses are not required, chronic schizophrenic subjects apparently do not extend the associative process to the point of developing an emotional (autonomic) reaction to outside verbal stimuli unless the word meanings symbolize imminent stiuational pain.

In the present situation one is reminded of a fairly classic distinction between fear and anxiety. "In some instances fear is the response to a danger signal or symbol of impending possible injury" (Shaffer, 1936, p. 201). "Anxiety is used . . . to mean concern over our own conduct, i.e., feelings of guilt. . . . Anxiety about our own feelings is undoubtedly one important form anxiety takes" (Hilgard, 1953, p. 131). That is, fear is thought of as a response to an immediately present real danger while anxiety is thought of

as a response to one's own ideas or impulses. This usage seems relevant in the present context. The patients seem, ordinarily (when not required to give verbal responses), able to avoid interaction with symbolic materials (leading to anxiety) even though they perceive them. They retain "contact with reality" as is evident by their vigilant reactions to threat of pain. Further, chronic schizophrenic subjects have the potential for interacting with and giving affective reactions to subtle symbolic stimuli as is evident in the GSRs to "loaded" vs. "neutral" words during set-to-respond.

The evidence runs contrary to much that has been written about schizophrenia. The notion that chronic schizophrenic subjects are deficient in "reality testing" requires modification. While it may be true that these patients do not go out of their way to seek out reality and that overt behavior is grossly disturbed, they, nevertheless, appear to maintain a level of vigilance which enables them to sort out incoming stimuli. They appear to react appropriately to fear producing stimuli, but anxiety reactions seem dormant unless the situation induces greater than usual involvement.

To summarize the findings on autonomic reactivity (GSRs) to specific stimuli, when left to their own devices (set-to-

perceive) chronic schizophrenic subjects failed to react differentially to "loaded" vs. "neutral" words. Yet, when instructed to give verbal associations (set-to-respond) the same subjects gave differential GSRs to words which were not significantly different from those of control subjects. They also responded autonomically to threat of pain presented verbally and sham-pain presented with gestures to a degree not significantly different from control subjects. Reactions to actual pain, of course, were not significantly different from normal controls. These facts are interpreted to mean that, even when patients appear to be grossly out of contact, as evident by absent or inadequate word associations, the autonomic mechanisms of affective response are not defective, their perception of meaning seems intact, and they are alert to situational threat presented both in verbal form and with gestures. At the same time, they fail to give affective (anxiety) reactions to conceptual-emotional material except when participation or involvement is induced by response set instructions.

Absolute GSR Magnitudes During Overt-Verbal Responses

In the previous discussion, GSRs to words have been considered with respect to differential reactions to "loaded"

vs. "neutral" words. In this section, however, it is the absolute magnitude of the GSRs across all word classes which is considered. The findings were that, during set-to-perceive, GSRs were not significantly different between groups. That is, combining reactions to both word classes the groups did not differ in magnitude of GSRs during set-to-perceive. However, during set-to-respond, GSR amplitudes were significantly different between groups.

During set-to-perceive the GSRs are assumed to be mainly a function of momentary reactions to the stimuli. During set-to-respond, however, the effect of the verbal response itself is included in the GSRs. The group of chronic schizophrenic subjects who failed to give adequate verbal responses gave GSRs, during set-to-respond, which were approximately of the same magnitude as they had previously given during set-to-perceive. In contrast, those chronic schizophrenic subjects who gave minimally adequate verbal responses gave greater GSRs during the verbal responses (set-to-respond) than previously, and the normal control subjects had the greatest increase in magnitude of GSRs.

It is evident from authoritative sources (Duffy, 1951; Freeman, 1948; Woodworth & Schlosberg, 1958) that GSRs are also a measure of response effort. "It is the energy used in

tensing the muscles in preparation for overt response as well as that used in the overt response itself" (Duffy, 1951, p. 34). In the present experiment the greater overall GSR amplitudes given by the control group during overt verbal responses (set-to-respond condition) is seen as a reflection of greater expenditure of energy in the responses. The schizophrenic subjects were frequently difficult to understand due to the faintness or lack of force in their speech. Further, their responses did not seem to be given as promptly as those of the control subjects. The chronic schizophrenic subjects expended less energy in their responses as was evident in their GSRs to words which were lesser in amplitude than those of the normal control subjects. This finding is an obvious corollary to the deficits in overt-voluntary responses which have been reported throughout the literature.

Before passing on from this finding, it is possible that it negates an interpretation of inhibition of or suppression of response in chronic schizophrenic subjects. Were there a response vs. no-response conflict, it would seem that either or both greater GSRs and conductance levels would prevail during the response series. It is assumed, since such results were not found, that response failure in chronic schizophrenic subjects is possibly a matter of diminished

"set-to-respond" rather than a matter of suppressing or inhibiting a response for which the person is set. This interpretation is further supported by the data on preparation of sets.

Set-to-Perceive and Set-to-Respond

Preparatory sets. In the present experiment an attempt was made to compare differences in preparing sets for a perception task with preparing sets for a perception plus overt response task. The results indicate that all groups increase activation approximately to the same extent in preparations for the perception-only task (set-to-perceive) while control subjects significantly exceeded the chronic schizophrenic subjects in increased conductance while preparing for the task in which they were to give an overt verbal response (set-to-respond). This finding is consistent with the hypothesis that chronic schizophrenic subjects are deficient in preparations for overt responses.

However, two alternate explanations should be considered. One explanation would be that shifts in conductance were reactions to the instructions as noise. Coming at the end of a period of relaxation, the set-to-perceive instructions, for example, may have been disquieting as auditory

stimuli irrespective of their meaning. This possibility was considered in planning the procedures, and a 15 second pause was allowed following the instructions before the change in conductance was measured. During this period, GSRs to specific sensory stimuli would ordinarily be completed, leaving only the effect of preparatory or anticipatory activation. Rosenthal et al. (1960), for example, found that preparatory intervals between 4 and 7.5 seconds were critical for loss of set in chronic schizophrenic subjects. Fifteen seconds was chosen both to avoid GSRs to specific sensory stimuli and to maximize the differences in preparatory set between schizophrenic and control subjects.

A second alternate explanation is that instead of being preparations for response, as such, the increases may have been due to greater "emotionality." That is, having prior knowledge of the kinds of stimuli to be expected ("loaded" words) and being more sensitive to the social implications of their own associations to these words, the control subjects may have suffered anticipatory embarrassment. Were this the case, however, it would be expected that GSRs to "loaded" vs. "neutral" words would not only be greater for the control group during set-to-respond as is found, but that this difference would be much more pronounced than in their own

reactions during set-to-perceive, which was not found. Further, it would be expected that the "loaded" vs. "neutral" word differences during set-to-respond would be more pronounced in the control group than in the chronic schizophrenic groups. That these differences were not found is evidence also for favoring the preparatory set hypothesis.

The finding that chronic schizophrenic subjects show less evidence of preparing sets to respond is consistent with the findings of the reaction time studies of response set (Huston et al., 1937; Knehr, 1954; Rodnick & Shakow, 1940; Rosenthal et al., 1960; Tizzard & Venables, 1956). However, the failure to find significant differences between groups in preparations for the perception task (set-to-perceive) poses a problem in extending the supposed area of deficit to "mental set," in general, for chronic schizophrenia and would tend to restrict the demonstrated deficit to set to respond only.

One interesting additional finding is that the two chronic schizophrenic groups did not differ significantly in increases in conductance for either condition. Despite the fact that one group gave minimally adequate verbal responses while the other did not there were no significant differences in the conductance increases. It would appear, therefore, that deficits in preparatory sets to respond were common to

both chronic schizophrenic groups despite the differences in quality of the overt verbal responses.

Maintenance of sets. No significant differences between groups were found in conductance levels near the end of the set-to-perceive or set-to-respond conditions. Trends in set-to-respond favoring greater maintenance of sets in control subjects probably represent a carry-over of the initial sets which did not entirely dissipate during the response series. On the basis of these data, one of the hypotheses was rejected. Since the "adequate" verbal responding chronic schizophrenic group did not show increased conductance levels during set-to-respond, it cannot be said that in giving adequate verbal responses chronic schizophrenic subjects require a comparatively greater increase in level of autonomic activation. Instead, these subjects manifest a relatively smaller increase in level of activation and give responses with diminished GSRs. Along these lines, it was observed during the experiment, by both experimenter and assistant, that the verbal responses of schizophrenics were given with less force of voice and greater latency.

CHAPTER VI

SUMMARY AND CONCLUSIONS

The study of chronic schizophrenia, as a separate problem, has been largely neglected. The early descriptive writers characterized it as a condition eventuating in a vegetative existence and a state of "idiocy." There is confusion in the state of knowledge about chronic schizophrenia since most scientific investigators have not separated this group from others. Further, experimental samples seem biased in favor of "cooperative" subjects, somatic therapies are not controlled, and rapport with subjects is often questionable. The findings from various experiments are often contradictory, perhaps for these reasons.

The experimental literature bearing on chronic schizophrenia has uniformly agreed on the existence of overt response deficits of a wide variety. However, investigations of the less obvious intervening processes have produced fragmentary and often conflicting results. One of the

earliest and continuing lines of investigation has been the study of autonomic indices of affective reactions to various stimuli. Most previous authors stress a general diminution of autonomic reactions to a wide variety of stimuli, and the results are interpreted, by them, as evidence of general withdrawal. Deficits in level of autonomic activation, attention, and response set have also been reported. However, these problems have not been investigated simultaneously in the same group of subjects.

The present study was designed to investigate, within the same group of chronic schizophrenic subjects, a series of related hypotheses derived from the experimental literature, namely that chronic schizophrenia is characterized by withdrawal associated with low levels of autonomic activation, inattention to external events, failure to organize and maintain response sets, and decreased autonomic reactions to external conceptual stimuli but adequate responses to physical pain stimuli. These hypotheses were tested by obtaining continuous galvanic skin response records under a variety of stimulus conditions.

The subjects were 34 randomly selected chronic schizophrenic women hospitalized 7 or more years and 20 psychiatric aides of similar age and socio-economic status. The

schizophrenic subjects had been removed from all somatic therapies for more than a year prior to the study. Rapport with the subjects was based upon three years of continuous contact.

The apparatus for measuring galvanic skin response was an electrical circuit with a Wheatstone bridge arrangement and a D. C. amplifier. Conductance levels and changes were continuously recorded on an Esterline-Angus graphic recorder. Prior to the experiment the instrument was calibrated with the use of an external decade box. The electrodes, which were attached to the first and middle finger of the right hand, minimized electrical artifacts and error due to variations in area of contact.

The experimental procedures began with a period of relaxation, after which all subjects were administered a modified word association procedure containing "loaded" and "neutral" words under instructions to "listen and think about the words" but not respond (set-to-perceive condition). An equivalent word association procedure followed with instructions to respond verbally (set-to-respond condition). After an intermediate relaxation period there followed a statement of intent to obtain a blood sample, preparation of a finger with cotton and alcohol, sham penetration, and

actual penetration of the skin with a blood lancet. A final relaxation period completed the experimental procedures.

On the basis of a reliable criterion of adequacy of word association responses, the chronic schizophrenic subjects were divided into 20 "adequate" responders and 14 "inadequate" responders. The 20 control subjects all gave adequate verbal responses.

The findings were:

1. Chronic schizophrenic and normal groups did not differ significantly in overall skin conductance levels.

2. All groups significantly increased skin conductance levels after initiation of instructions but before word stimuli were presented in the set-to-perceive and set-to-respond conditions. However, normal control subjects increased skin conductance levels to a significantly greater extent following set-to-respond instructions than the chronic schizophrenic groups. The latter did not differ from one another significantly.

3. No significant differences between groups were found in skin conductance levels at the end of either set-to-perceive or set-to-respond conditions.

4. No significant differences between groups were found in GSRs to "threat of pain," "prepare finger," "sham-

pain," or "pain."

5. No significant differences between groups were found in GSRs to words during set-to-perceive. However, during set-to-respond, while verbal responses were being given, the normal control group gave significantly greater GSRs than the verbally "adequate" chronic schizophrenic group which, in turn, gave greater GSRs than the verbally "inadequate" chronic schizophrenic group.

6. Significantly greater GSRs to "loaded" vs. "neutral" words were given by the control group compared with the schizophrenic groups in the set-to-perceive condition only. During set-to-respond all groups gave significantly greater GSRs to "loaded" vs. "neutral" words, while the differences between groups, in this respect, were not significant.

These findings are interpreted to mean that chronic schizophrenic subjects, contrary to some previous experimental reports, are not characterized by a disturbed level of autonomic activation or by a lack of autonomic reactivity to threat-pain stimuli. Further, the ability to establish sets to perceive apparently is intact but deficit occurs in the level of establishing sets to respond overtly and in energy expended in specific overt responses. Chronic schizophrenic subjects are potentially able to react differentially

to subtle conceptual stimuli with affective connotations but in the absence of task involvement, induced by instructions to give overt verbal responses, differential affective reactions are diminished or absent.

At a more general level, the findings of this experiment lead to a more optimistic view of chronic schizophrenia than is found in much of the literature. These patients are much more accessible and reactive affectively to environmental stimuli than their disturbed outward expressions and overt behavior would lead one to believe. The patients seem potentially sensitive to all classes of stimuli. The main deficit appears to be in their getting set to respond and in executing overt responses.

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APPENDIX A. WORD LISTS

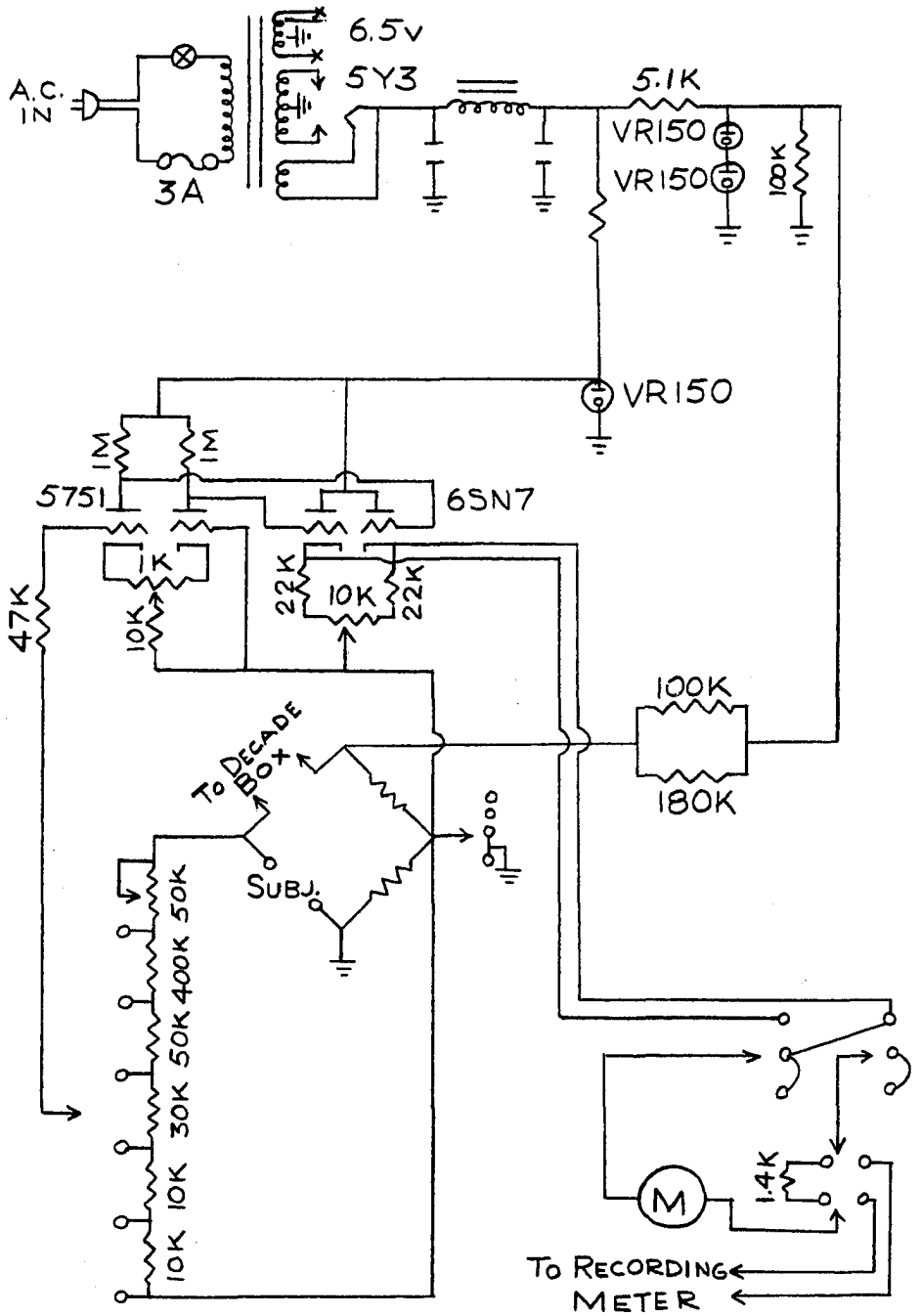
Word Lists

List A	List B
Bird	Flower
Sheep	Horse
Rest	Sit
Spring	Tree
Box	Table
Mother*	Love*
Walk	Talk
Room	Door
Hate*	Fear*
Give	Laugh
White	Coat
Sick*	Kiss*
Sleep	Wash
Dog	Cow
Marriage*	Angry*
Glass	Chair
Swim	Music
Sin*	Death*
Dish	Needle
Pond	Carrot
Divorce*	Sex*
Stop	Stop

*Loaded words.

APPENDIX B. CIRCUIT DIAGRAM

Circuit Diagram



APPENDIX C. TESTS OF HOMOGENEITY OF VARIANCES

SUPPLEMENTARY ANALYSES OF VARIANCE

Bartlett's Tests[a] of Homogeneity of Variances for Conductance Levels and GSRs

Source of Data	S #8[b]	d.f.	Chi^2	p
Preparing sets (C[c] before and after instructions in set-to-perceive and set-to-respond).	included	11	25.35	$<.01$
	excluded	11	8.80	$>.50$
Maintenance of sets (C before and after set-to-perceive and set-to-respond conditions).	included	11	21.34	$<.05$
	excluded	11	10.92	$>.50$
Overall levels of activation (C at 7 points of measurement).	included	20	33.83	$<.05$
	excluded	20	9.66	$>.95$
Reactions to threat-pain stimuli (GSRs[c] at 4 points of measurement).	included	11	11.93	$>.20$
Reactions to words (GSRs without transformation).	included	11	91.20	$<.01$
Reactions to words (expressed as $100\sqrt{GSR}$).	included	11	13.35	$>.20$[d]

[a]Edwards (1950, p. 198).

[b]S #8 is the deviant control subject with very high conductance.

[c]C = conductance level (Mhos x 10^{10}); GSR = change in C.

[d]Log and cube root transformations both failed to produce homogeneous variances.

Analysis of Variance I (supplementary): Conductance Levels Before and After Set Instructions

(Subject #8 has been deleted)

Source	d.f.	MS	F	p
Total	211			
Between Subjects	52			
Groups (G)	2	2.50	.00	- -
Error (b)	50	681.18		
Within Subjects	159			
Time (T)	1	1,565.00	49.04	<.001
Set (S)	1	632.00	19.81	<.001
T x S	1	216.00	6.77	<.01
G x T	2	166.50	5.22	<.01
G x S	2	47.00	1.47	>.20
G x S x T	2	97.50	3.06	<.05[a]
Error (w)	150	31.91		

[a]In the original analysis, with subject #8 included, the G x S x T interaction probability level was between .10 and .05. The remaining tests of significance yielded the same decisions in all cases.

Analysis of Variance II (supplementary): Conductance Levels Before Instructions and at End of Set Conditions

(Subject #8 has been deleted)

Source	d.f.	MS	F	p
Total	211			
Between Subjects	52			
Groups (G)	2	73.00	.01	- -
Error (b)	50	693.86		
Within Subjects	160			
Time (T)	1	64.00	3.45	<.10[a]
Set (S)	1	202.00	10.89	<.001
T x S	1	13.00	.70	- -
G x T	2	42.00	2.26	- -
G x S	2	18.50	1.00	- -
G x S x T	2	49.50	2.67	<.10
Error (w)	150	18.55		

[a]In the original analysis this value was <.05. However, the interpretation is not affected since hypotheses dealt with interactions.

Analysis of Variance V (supplementary): Conductance Levels Throughout the Experiment

(Subject #8 has been deleted)

Source	d.f.	MS	F	p
Total	370			
Between Subjects	52			
Groups (G)	2	177.00	.19	- -[a]
Error (b)	50	936.46		
Within Subjects	318			
Conditions (C)	6	893.67	22.30	<.001[a]
G x C	12	45.58	1.14	>.20[a]
Error (w)	300	40.08		

[a]These probability levels are identical with the original analysis.

APPENDIX D. INDIVIDUAL SCORES (RAW DATA)

Individual Conductance Levels Throughout the Experiment

(Units are mhos x 10^{10})

S no.	Initial level	End relax I	End set-to-perceive	End set-to-respond	End relax II	Pain plus 15"	End relax III
			Normal control subjects				
1	36	35	37	38	30	28	24
2	45	39	36	37	36	41	35
3	25	23	25	25	24	26	22
4	25	23	25	25	24	26	22
5	25	16	15	13	14	32	20
6	39	23	24	29	19	32	20
7	43	36	32	45	35	61	40
8	98	90	99	103	82	103	77
9	22	14	18	19	12	22	12
10	28	15	16	30	19	34	22
11	29	31	37	40	46	45	42
12	29	27	27	27	23	28	23
13	29	37	39	39	35	40	31
14	10	7	8	11	8	19	7
15	29	15	15	37	30	49	19
16	39	39	37	36	32	41	31
17	40	45	43	37	36	38	31
18	53	52	51	70	58	71	58
19	46	47	42	48	43	48	52
20	53	54	50	52	50	57	53
			Minimally adequate verbal responders				
21	42	32	35	31	32	38	32
22	64	44	37	26	40	48	27
23	34	21	26	29	29	36	24
24	36	31	30	36	33	41	29
25	37	38	34	34	40	37	23
26	30	29	37	40	32	37	29
27	36	30	30	34	30	38	29
28	46	36	36	37	31	53	30

(Table continued on next page)

Conductance Levels Throughout--Continued

S no.	Initial level	End relax I	End set-to-perceive	End set-to-respond	End relax II	Pain plus 15"	End relax III
			Minimally adequate verbal responders--Continued				
29	48	66	66	53	45	56	48
30	25	20	20	24	24	30	23
31	18	12	11	16	13	32	15
32	30	29	25	21	17	24	20
33	69	33	31	37	32	53	37
34	36	32	33	31	15	39	22
35	53	57	65	67	61	72	60
36	22	11	23	34	21	49	23
37	35	37	43	47	45	48	35
38	21	31	31	28	33	38	27
39	31	32	35	34	33	38	35
40	28	21	18	23	18	23	17
			Inadequate verbal responders				
41	45	34	32	33	31	38	33
42	49	26	21	32	33	48	26
43	44	55	63	69	68	65	62
44	66	50	44	41	45	49	43
45	26	15	10	13	24	37	12
46	36	35	39	40	31	47	35
47	26	11	8	10	7	44	12
48	60	56	55	58	39	36	38
49	31	39	38	36	34	42	30
50	41	36	25	26	30	50	23
51	34	33	30	30	29	30	33
52	50	35	36	31	28	43	29
53	39	12	21	20	29	58	30
54	36	29	26	22	25	31	22

Individual Conductance Levels Before and After Instructions and at End of "Perceive" and "Respond" Conditions

(Units are mhos x 10^{10})

S no.	Set-to-perceive			Set-to-respond		
	Instructions Before	Instructions After	End of condition	Instructions Before	Instructions After	End of condition
	Normal control subjects					
1	35	40	37	38	48	38
2	39	39	36	37	43	37
3	14	15	14	15	42	35
4	23	24	25	25	27	25
5	15	18	15	15	20	13
6	23	31	24	23	46	29
7	35	36	32	31	33	45
8	90	110	99	101	121	103
9	14	29	18	18	32	19
10	14	16	16	17	31	30
11	32	34	37	43	52	40
12	27	32	27	28	31	27
13	38	47	39	44	53	39
14	7	8	8	8	15	11
15	14	19	15	14	66	37
16	37	40	37	37	43	36
17	44	50	43	41	46	37
18	51	52	51	51	75	70
19	47	58	42	44	71	48
20	56	57	50	49	57	52
	Minimally adequate verbal responders					
21	32	36	35	33	33	31
22	42	45	37	36	35	26
23	20	29	26	24	42	29
24	29	28	30	30	34	36
25	38	38	34	33	35	34
26	29	37	37	33	42	40

(Table continued on next page)

Individual Conductance Levels--Continued

S no.	Set-to-perceive			Set-to-respond		
	Instructions Before	Instructions After	End of condition	Instructions Before	Instructions After	End of condition
	Minimally adequate verbal responders--Continued					
27	29	32	30	30	39	34
28	35	35	36	45	41	37
29	62	66	66	52	50	53
30	20	25	20	21	25	24
31	12	12	11	11	13	16
32	29	29	25	24	23	21
33	33	50	31	40	49	37
34	32	39	33	32	39	31
35	57	57	65	60	65	67
36	11	12	23	22	23	34
37	38	38	43	50	48	47
38	30	32	31	43	42	28
39	31	41	35	34	59	34
40	21	21	18	18	20	23
	Inadequate verbal responders					
41	33	35	32	32	36	33
42	23	31	21	20	39	32
43	58	55	63	66	63	69
44	48	48	44	54	48	41
45	14	14	10	14	24	13
46	34	34	39	40	38	40
47	10	16	8	22	20	10
48	56	60	55	55	58	58
49	39	40	38	37	39	36
50	35	34	25	25	52	26
51	30	34	30	30	30	30
52	35	36	36	37	40	31
53	12	15	21	20	21	20
54	28	32	26	25	25	22

Individual GSRs to "Neutral" and "Loaded" Words

(Units are $100\sqrt{\text{Mhos} \times 10^{10} \text{ change}}$)

S no.	Set-to-perceive		Set-to-respond	
	Neutral	Loaded	Neutral	Loaded
	Normal control subjects			
1	11.6	13.0	15.7	16.4
2	7.3	14.2	11.3	14.2
3	3.6	4.2	26.5	33.4
4	6.9	12.4	12.0	12.9
5	4.1	3.2	14.9	26.7
6	2.6	9.1	21.4	28.9
7	0.0	0.0	16.6	28.0
8	17.3	22.7	25.5	24.5
9	4.0	17.1	7.6	21.4
10	1.4	3.9	26.8	29.7
11	17.1	14.4	17.7	28.9
12	16.4	20.5	28.0	31.4
13	11.9	17.1	27.7	40.0
14	1.7	5.7	13.6	22.8
15	5.1	6.6	39.0	51.0
16	10.5	21.4	15.8	11.5
17	15.2	22.6	18.0	25.2
18	2.8	1.4	30.5	36.1
19	15.3	18.2	27.1	31.6
20	15.8	17.3	17.3	20.8
	Minimally adequate verbal responders			
21	11.2	12.0	6.0	5.3
22	24.7	8.4	12.9	18.7
23	12.2	9.1	24.1	31.4
24	10.1	11.7	21.3	27.8
25	11.2	24.7	17.3	10.0
26	12.9	10.0	23.1	25.0
27	11.6	13.6	16.4	18.0
28	11.8	14.1	11.2	19.1
29	16.3	10.0	8.1	15.3

(Table continued on next page)

Individual GSRs to Words--Continued

S no.	Set-to-perceive		Set-to-respond	
	Neutral	Loaded	Neutral	Loaded
	Minimally adequate verbal responders--Continued			
30	4.7	6.6	10.3	19.3
31	1.7	5.9	11.6	25.5
32	6.4	5.7	4.7	6.0
33	8.7	23.5	29.7	41.4
34	4.2	2.4	12.2	22.0
35	18.7	20.8	26.5	30.0
36	10.0	7.1	26.1	32.6
37	22.4	19.2	18.7	19.1
38	15.3	10.8	15.3	6.4
39	16.0	17.5	17.3	25.2
40	6.0	6.9	9.7	20.6
	Inadequate verbal responders			
41	7.9	7.1	8.4	13.4
42	14.2	4.0	8.7	16.9
43	18.2	25.5	19.6	30.5
44	25.2	17.8	13.8	8.7
45	4.0	6.0	5.0	15.0
46	7.4	16.1	14.7	24.5
47	7.1	5.1	0.0	0.0
48	24.5	0.0	23.4	22.4
49	9.8	17.6	12.2	8.7
50	6.4	10.8	11.2	9.1
51	19.6	9.1	14.1	32.4
52	4.0	8.4	0.0	1.7
53	8.5	5.6	0.0	1.7
54	7.7	5.7	10.8	4.0

GSRs to Threat-Pain Stimuli

(Units are mhos x 10^{10} change)

S no.	Threat	Prepare finger	Sham pain	Pain
		Normal control subjects		
1	2	5	5	5
2	17	12	19	12
3	63	59	33	44
4	8	3	9	3
5	8	23	20	8
6	22	17	18	18
7	9	48	32	36
8	70	23	22	22
9	9	18	12	22
10	34	14	18	17
11	48	4	40	40
12	28	15	27	27
13	38	17	15	18
14	19	40	30	31
15	47	42	54	55
16	18	6	14	12
17	23	10	8	18
18	4	28	49	29
19	51	18	38	31
20	9	27	15	12
		Minimally adequate verbal responders		
21	3	32	24	45
22	42	65	61	58
23	1	19	15	19
24	5	37	34	21
25	9	8	35	25
26	58	31	31	17
27	14	19	16	6
28	8	21	32	23
29	13	2	4	3

(Table continued on next page)

GSRs to Threat-Pain Stimuli--Continued

S no.	Threat	Prepare finger	Sham pain	Pain
		Minimally adequate verbal responders--Continued		
30	16	22	19	17
31	1	20	20	17
32	15	2	1	5
33	55	49	16	17
34	30	13	20	32
35	4	36	20	19
36	3	32	24	45
37	8	9	22	25
38	2	7	5	7
39	14	8	17	6
40	5	11	19	17
		Inadequate verbal responders		
41	3	9	9	6
42	21	50	8	24
43	32	24	19	22
44	27	7	8	2
45	2	38	15	26
46	47	28	19	27
47	19	23	33	33
48	12	17	22	17
49	25	13	9	15
50	33	7	34	32
51	17	9	16	14
52	12	22	6	18
53	2	23	23	39
54	45	22	1	17