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THE PSYCHOPHYSIOLOGICAL FUNCTIONING OF CHILDREN WITH SCHIZOPHRENIC MOTHERS

by
David E. Silber

A dissertation submitted in partial fulfillment
of the requirements for the degree of
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TABLE OF CONTENTS

	Page
ACKNOWLEDGEMENTS	ii
LIST OF TABLES	v
LIST OF ILLUSTRATIONS	vii
INTRODUCTION	1
Introductory Statement	
Theoretical Orientation	
Relevance to the Process-Reactive Dimension	
Need to Test Assumptions about Responsiveness	
The Psychiatric-Genetic Research Findings	
The Present Experiment and the Schizophrenia Research Project	
Research on Pre-Schizophrenic Persons	
Research with Children of Schizophrenic Parents	
Psychophysiological Measure of Reactivity	
Skin Resistance Research with Schizophrenic Ss	
Hypotheses of the Experiment	
METHOD	23
Procedure	
Apparatus	
Differentiation of Subgroups	
Subjects	
Scoring	
RESULTS	34
Experimental-Control Group Analyses	
Process-Reactive Subgroup Comparisons	
The Current Mental Health Scale Subgroup Analyses	
Summary of Results	

Page

DISCUSSION 59

Primary Group Comparisons
Pre-Schizophrenic Psychophysiological Responding: Hypotheses
The Process-Reactive Subgroup Comparisons
The Current Mental Health Subgroup Comparisons
Implications of the Present Experiment

SUMMARY 71

APPENDIX A: GROUP VARIANCES 75

BIBLIOGRAPHY 83

LIST OF TABLES

Table		Page
1.	The Process-Reactive Rating Scale	28
2.	Mean Scores and Number of Subjects in the Process-Reactive Subgroups	29
3.	The Current Mental Health Scale	30
4.	Number of Subjects and Mean Scores for the Current Mental Health Scale Subgroups .	31
5.	Mean Characteristics of the Experimental and Control Groups	32
6.	Age Differences in Basal Resistance Level (Ohms) at Selected Points and in Mean GSR (Ohms) across Trials	37
7.	Mean Basal Skin Resistance (Ohms) at Selected Points	38
8.	Mean Changes in Basal Skin Resistance from the Beginning of the Session to the End of Rest Period and End of Session . . .	39
9.	Mean GSR (Ohms) to the First and Eighth Desensitization Trials	40
10.	Mean GSR (Ohms) on the First, Third, Seventh and Ninth UCS Trials	41
11.	Mean Amount of Recovery (Ohms) on the First, Third, Fifth, Seventh and Ninth UCS Trials	44
12.	Mean Recovery Time (in Seconds) on the First, Third, Fifth, Seventh and Ninth UCS Trials	44
13.	Mean Response Latency (in Seconds) on the First, Third, Fifth, Seventh and Ninth UCS Trials	45

Table		Page
14.	Mean GSR (Ohms) of Groups P and R and Subgroups EP, ER, CP and CR on the First, Third, Fifth, Seventh, and Ninth UCS Trials	48
15.	Mean Amount of Recovery (Ohms) for Subgroups EP, CP, ER, and CR on the First, Third, Fifth, Seventh and Ninth UCS Trials	49
16.	Mean Recovery Time (in Seconds) for Groups P and R and Subgroups ER, EP, CR and CP on the First, Third, Fifth, Seventh and Ninth UCS Trials	50
17.	Mean Response Latency (in Seconds) for Subgroups EP, ER, CP and CR on the First, Third, Fifth, Seventh and Ninth UCS Trials	50
18.	Mean GSR (ohms) of Subgroups EB, EG, CB and CG on the First, Third, Fifth, Seventh and Ninth UCS Trials.	53
19.	Mean Recovery Time (in Seconds) for Groups G and B and Subgroups EG, EB, CG and CB on the First, Third, Fifth, Seventh and Ninth UCS Trials	55
20.	Mean Latency (in Seconds) for Groups G and B on the First, Third, Fifth, Seventh and Ninth UCS Trials	56
21.	Mean Response Latency (in Seconds) for Subgroups EB, EG, CB and CG on the First, Third, Fifth, Seventh and Ninth UCS Trials	57

LIST OF ILLUSTRATIONS

Figure		Page
1.	Experimental Arrangement	25
2.	Mean GSR of Groups E and C across Trials .	42
3.	Mean Latency of Groups E and C by Age Levels for the Fifth, Seventh and Ninth UCS Trials	47
4.	Mean Latency for Subgroups EP, ER, CB and CR on the First, Third, Fifth, Seventh and Ninth UCS Trials	51
5.	Mean GSR of Subgroups EB, EG, CB and CG on the First, Third, Fifth, Seventh and Ninth UCS Trials	54

INTRODUCTION

Introductory Statement

The purpose of this study is to compare the psychophysiological responding of a group of children with a high risk of becoming schizophrenic with that of a low-risk group of children. By comparing these two groups on a number of psychophysiological variables such as their basal skin resistance level, their galvanic skin response to discrete stress stimuli, and their recovery rates, it is hoped to provide information about factors which have theoretical importance in the etiology of schizophrenia.

Theoretical Orientation

Psychological theories of the etiology of schizophrenia give prominence to the role of emotion and reaction to stress. Freud (1959), in one of the first essays on the causative factors in mental illness (originally published in 1894), emphasized that it was a reaction to unbearable emotions engendered by environmental stress. Under the impact of the emotions, the ego tore itself from reality, and psychosis ensued. Sullivan (1953) postulated that massive anxiety adversely affects the developing personality of the pre-schizophrenic and is primarily responsible for precipitating the illness. Jung (1939) early stressed the psychodynamic factors involved in schizophrenia. He conceived of it as a "living dream" engendered by a flood of unconscious emotions. Similarly, more recent theories have stressed the etiological importance of intense emotionality. Though not

conceived of as providing an explanation, anxiety is viewed as the primary emotion from which the schizophrenic person is trying to escape (cf., Bateson, Jackson, Haley & Weakland, 1956; Fromm-Reichmann, 1959; Searles, 1959). Arieti (1955) has described the early stage of schizophrenia as one in which the person is intensely anxiety-ridden and is seeking means to allay it.

Perhaps the most intensive attempt to establish anxiety as an etiological factor--indeed, the etiologically relevant factor--is a recent learning-theory approach to schizophrenia (Mednick, 1958; 1961). The theory assumes that persons who are prone to become schizophrenic manifest a greater than normal reaction to anxiety-provoking stimuli, and a slower than average return to normal or basal levels of functioning. This abnormally high reactivity is conceptualized as heightened arousal which, due to the nature of the stimulus, is experienced by the person as anxiety. While intense anxiety is generally implicated in other psychodynamic theoretical formulations, Mednick's theory is unusual in the specificity assigned to this factor.

The theory states that in situations where stressful stimuli are present, the schizophrenia-prone individual experiences a heightened anxiety response, which has a slower than normal decay rate. The theory makes an additional assumption that the pre-schizophrenic has an abnormally high generalization reactivity. These three assumptions have been incorporated into a behavior learning theory framework: as anxiety increases, the schizophrenia-prone person's generalization gradient becomes flatter; that is, previously neutral stimuli acquire the power to elicit anxiety. The more stimuli capable of eliciting anxiety, and the longer the recovery period, the more anxiety-provoking stimuli are

experienced. Thus a spiral is established, termed "reciprocal augmentation" (Mednick, 1958): stimuli provoke anxiety, and thus increase the number of stimuli capable of evoking the emotion. When anxiety has reached intense proportions, any behavior which reduces anxiety will be reinforcing. Mednick hypothesizes that both the disordered thinking and idiosyncratic behavior prominently found among schizophrenic persons originated as learned anxiety-reducing behaviors.

As mentioned previously, the assumption of high anxiety-responsiveness in schizophrenics is central to the theory. Presumably, if a schizophrenic person is in a situation where he cannot avoid experiencing stress, he will show heightened and prolonged anxiety. This assumption finds support among reported EEG studies, assuming that an electroencephalographic (EEG) recording session qualifies as an unavoidable stress situation to a schizophrenic subject (S). The EEG has been used as a measure of central arousal (Lindsley, 1951) which, it is assumed, is correlated with the experience of anxiety, at least when arousal is triggered by stressful situations. Low voltage fast waves have been assumed to indicate high arousal (Lindsley, 1951), and have been found to occur in approximately 6 percent of normal records (Gibbs & Gibbs, 1942). The percentages of low voltage fast waves in samples of schizophrenic Ss has been reported to be as high as 64 percent (Borenstein & Dabbak, 1957) and as low as 16 percent (Lyketsos, Belinson, & Gibbs, 1953). The number of fast-wave records in five other studies averages out to 36 percent (Colony & Willis, 1956; Hurst, 1952; Kennard & Levy, 1952; Kennard, Rabinovitch & Pfister, 1957; Newman & Lawrence, 1952). Additional research has lent support to other aspects of the theory as well: Mednick & Wild (1962) reported evidence supporting the "reciprocal

augmentation" concept in a conditioning experiment; Mednick & DeVito (cited in Mednick, 1958) reported differential susceptibility to associative response competition in a verbal learning task, which they attributed to different levels of arousal characteristic of different stages of the illness. Similarly, differences on learning (Mednick, 1959) and performance tasks (Higgins & Mednick, 1963) were in accord with predictions drawn from the theory.

Relevance to the Process-Reactive Dimension

Recently the process-reactive dimension has come into prominence as a result of findings concerning the pre-morbid history of persons with schizophrenia. Originally, the process-reactive distinction was formulated in order to distinguish schizophrenic persons with good prognoses from those with poor prognoses (Kantor, Wallner & Winder, 1953; Phillips, 1953). Considering only the pre-morbid history, it has been found those individuals with the poorest prognosis had (a) few or no intimate social or sexual relationships; (b) gradually became ill, with the process occurring over several years; and (c) had poorly integrated personality characteristics. These individuals are referred to as process schizophrenics. Those individuals with the best prognoses had (a) normal or near normal social and sexual relationships; (b) became ill rapidly, over a short period of time; and (c) had well-integrated personalities. These individuals are referred to as reactive schizophrenics. It has been suggested that the process and reactive types of pre-morbid patterns are end-points on a continuum (Kantor & Winder, 1959; Rodnick & Garmezy, 1959; Higgins, 1964). Obviously the process-reactive distinction has implications for the learning theory approach to schizophrenia.

Thus, it is possible that persons with a "process" background begin learning to avoid anxiety-provoking stimuli quite early; persons with "reactive" backgrounds, on the other hand, do not have to learn to avoid anxiety-provoking stimuli, perhaps because they have the benefit of benign environments (Mednick, 1961). According to the theory, those schizophrenic persons with "reactive" backgrounds would clearly show abnormally high reactivity to stress and slower than normal recovery during the pre-morbid phase. The situation is more complicated for those schizophrenics who had a "process" background during the pre-morbid period, for they would be avoiding stress even during adolescence, and might show normal, lessened, or slightly heightened reactivity to stress, depending on the extent to which they have already learned anxiety-avoiding behaviors. However, they would, according to the theory, show longer than normal recovery periods, regardless of whether they were under-aroused by stress. It is clear that a test of the theory's assumptions would have to take the process-reactive distinction into account.

Need to Test Assumptions about Responsiveness

Despite the large amount of data on already-schizophrenic Ss, the assumptions of the theory have not been adequately tested. The difficulty in testing the assumptions is the same as that encountered in any attempt to evaluate variables of etiological significance: the results of testing Ss who manifest schizophrenia inexorably confound the etiologically important variables with factors arising from the effect of the disease process itself. Thus, the EEG evidence reviewed previously--and cited as evidence in support of the theory--could conceivably have been a secondary

characteristic of schizophrenia, rather than primary. A further complication is that hospitalization for any length of time (and most research has been done with chronic schizophrenic Ss) has effects which are often difficult to assess or control for. Kety (1960) has succinctly summarized the difficulties of research with chronically hospitalized Ss. One illuminating example may be cited, where ". . . certain abnormalities in thyroid function previously reported in schizophrenia . . . [were] correctable by the introduction of iodized salt into the hospital diet" (Kety, 1960, p. 122).

Two ways of obviating this difficulty come to mind: (a) the use of some retrospective technique, or (b) testing schizophrenia-prone persons before they manifest the illness. Considering only the former, there have been numerous attempts to isolate relevant variables through interviewing the schizophrenic person himself about his pre-morbid background (e.g., Garmezy, Clarke & Stockner, 1961; Heilbrun, 1960; Reichard & Tillman, 1950), or interviewing the mother, father, or both (cf., Tietze, 1949; Gerard & Siegal, 1948; Guertin, 1961; Mark, 1953; Prout & White, 1956). Aside from the fact that the factors which can be investigated are limited to remembered relationships, these studies suffer from selection difficulties: only cooperative Ss can be used, which would almost certainly tend to bias the results. However, these studies have been of importance in highlighting the amount of intrafamilial pathology existing. Unfortunately, none of them threw light on processes operating within the pre-schizophrenic, such as those hypothesized by the theory.

Some research, to be reported in detail later, has utilized pre-existing records. Though the majority of them to date have reported on early intelligence test reports,

the design is highly promising. As institutions have become aware of the problem, records have become more complete and future research in the area may be of real significance. Up to the present, however, the findings have been rather limited.

The second possibility cited involved testing high-risk individuals before they manifested schizophrenia. This has been difficult to put into practice due to the complications of obtaining such a sample. The prevalence of schizophrenia in the general population has been estimated at approximately one percent (Book, 1960); thus, a given individual has about one chance in a hundred--all other things being equal--of developing schizophrenia during the ages of 15-44. A random sample, therefore, might constitute an adequate low-risk group, but certainly a more refined method is needed to obtain a high-risk group. So far, no way has been developed to isolate pre-schizophrenic individuals through psychological, neurological, or biochemical tests (Kety, 1960; Winder, 1960). However, the problem of selection of such a sample might be solved by turning to the psychiatric-genetic literature, which provides a useful source of information.

The Psychiatric-Genetic Research Findings

As Meehl has pointed out (1962), the results of genetically-oriented investigations of schizophrenia consistently have shown a high degree of concordance among members of the nuclear family. The most important and extensive work in the area has been reported by Kallman (1946). Kallman reported that the probability of developing schizophrenia given one schizophrenic parent was 16.4%, while the probability rose to 68% if both parents were schizophrenic. Among

twins, approximately 15% of dizygotic and 86% of monozygotic pairs developed schizophrenia when one became ill. Other investigators have reported approximately similar, of somewhat lower, figures from their studies (Fuller & Thompson, 1960). A recent study in Denmark now being prepared for publication (cited by Mednick & Schulsinger, in press) found that 12.7% of the children of 98 schizophrenic mothers had been admitted to Danish hospitals with a diagnosis of schizophrenia.

These statistics provide the possibility of a solution to the selection problem. Given a sample of children both of whose parents are, or at one time were, schizophrenic, then approximately two-thirds of them would eventually become schizophrenic themselves, according to Kallman's data. Even if only one parent were schizophrenic, the child's chances of becoming schizophrenic would be about sixteen times as great as that for a person with non-schizophrenic parents.

It should be pointed out that such an approach to the selection problem does not entail the assumption that a genetic factor determines the incidence of schizophrenia, for the studies cited above were primarily enumerational and did not report on the incidence of neurosis, psychosomatic disorders, etc., among the offspring of schizophrenic parents. Further, the twin factors of social environment (e.g., the impact of having a disturbed parent) and cultural heredity have been ignored in those studies. Other objections to a genetic conclusion have also been raised (Jackson, 1960; Rosenthal, 1962) that question the methodology or the logical conclusions. While the bias of the present writer is in favor of some psychological explanation, the nature-nurture controversy is secondary to the usefulness of the findings to the present study: the possibility of isolating a sample

of pre-schizophrenic Ss. Children of schizophrenic parents seemed more reasonable as a choice than schizophrenic co-twins, since co-twins might already be themselves affected.

The Present Experiment and the Schizophrenia Research Project

The purpose of this experiment was to test the hypothesis that persons prone to becoming schizophrenic have a higher than normal response to anxiety-provoking stimuli, and a slower than normal recovery rate. Though this hypothesis has emerged from the learning-theory approach, it is assumed to have a wider theoretical implication: it is assumed that the experiment may clarify the role of anxiety as an etiologically important factor in schizophrenia. The experiment is part of a multidisciplinary research project carried out in Copenhagen, Denmark, at the Psychological Institute of the Kommunehospitalet. The project has been described elsewhere in detail (Mednick, 1962; Mednick & Schulsinger, in press); it was designed as an attempt to test various aspects of the functioning of high- and low-risk Ss, and then to follow them up for several years. Since high-risk Ss frequently manifest schizophrenia, they are suitable for testing the hypothesis. The project was carried out in Denmark because the demographic characteristics of the country allowed relatively easy accessibility to the Ss: the majority of the population is centered in Copenhagen and environs, and their mobility is relatively low. By contrast, the mobility rate in certain areas of Detroit where most of the potential Ss would reside is at least 47% per year, and probably higher (U. S. census, 1956).

In light of the research on the process-reactive distinction, it was deemed important to isolate subgroups from

the experimental group (E) who could be rated as more process-like (EP) in their personality functioning, and those who could be rated as more reactive-like (ER). Similar subgroups from the control group (C) were also isolated for comparison (subgroups CP and CR). A Current Mental Health Scale was also constructed and the resulting subgroups were designated as EG (experimental good health), EB (experimental poor health), CG (control, good health), and CB (control poor health). The sample was composed of children whose mothers had been diagnosed as chronically ill with schizophrenia. It was decided to use children of schizophrenic mothers for several reasons: First, it obviated the problem of establishing paternity. Second, schizophrenic females have more children than schizophrenic males (Goldfarb & Erlenmeyer-Kimling, 1961), so that more Ss would be available. Mothers presumably exercise greater influence on their children's personalities than do fathers. Finally, offspring of "process" mothers have a higher incidence of schizophrenia than do offspring whose mothers have "atypical" schizophrenia (Schulz, 1939).

The standards set for inclusion of mothers (of experimental Ss) corresponded to those outlined in the Diagnostic and Statistical Manual (1952) of the American Psychiatric Association. The task of finding and contacting the Ss was simplified by the existence of the Folke Register, which lists current addresses for all people living in Denmark.

The present experiment utilized one portion of the initial data collected on the project. A session during the testing day was devoted to psychophysiologically determining the ease of conditioning and amount of generalization; the psychophysiological variables used in this determination including the galvanic skin response (GSR), heart-rate,

respiration, and electromygraphic responses. As part of the procedure skin resistance was recorded, as well as skin resistance changes to a discrete stressful stimulus: the stimulus was used as an unconditioned stimulus (UCS). The procedure thus lent itself to an analysis of basal skin resistance, and of reactivity to an anxiety-provoking stimulus. The rationale for utilizing skin resistance will be presented later, following a consideration of the evidence available on pre-schizophrenic Ss and on children of schizophrenic mothers.

Research on Pre-Schizophrenic Persons

There have been only a few studies of pre-schizophrenic individuals, and their results are not directly relevant to the present study; the majority of them utilized pre-existing records gathered by guidance or school agencies. In one study, however, an effort was made to isolate a sample of Ss likely to become schizophrenic in the future. Curtis (1962) attempted to do this by selecting a group of Ss from a training home for delinquents. The Ss selected were judged by a psychiatrist and psychologist to have a high potential for becoming schizophrenic because they were markedly disturbed. Curtis compared this group with two other groups--one "mildly withdrawn" and the other normal--from a public high school. Curtis reported that the markedly disturbed group, compared to either of the other two groups, manifested less use of assimilative projection, and had less clear-cut social-self identification. However, the markedly disturbed group were more favorable in their ratings of words connoting self-interest or self-absorption than either of the other two groups.

Of the studies utilizing pre-existing records, three

have been done on records from child study or child guidance centers. O'Neal & Robins (1958) have reported what is perhaps the most important of these. They found records of 28 children referred to a guidance center (for anti-social behavior, in the majority of cases), who were later diagnosed schizophrenic. These were compared with 57 records of Ss who developed without becoming psychotic. Compared to this control group, the pre-schizophrenic Ss showed, at the time of their referral, more physical aggression and lying; they were judged more dependent on their mothers, and had more somatic symptoms. Paranoid ideation was present in 32% of the pre-schizophrenic Ss but none of the "no-disease" group manifested them. The authors concluded that the anti-social behavior of the pre-schizophrenic group was their most striking abnormality. Two earlier reports (Friedlander, 1945; Birren, 1944) used samples of mixed pre-psychotic Ss obtained from two Chicago agencies. Friedlander (1945) reported on 16 schizophrenic, 9 "psychopathic" and 2 manic-depressive Ss admitted to hospitals before their twentieth birthday. Friedlander found that 75% of the pre-schizophrenic Ss had come from homes where there was severe friction (also reported by O'Neal & Robins, 1958). The majority were aggressive, and lacked self-confidence. Though the parental discipline was described as extreme (stern, indulgent, or both) and a high proportion of parents either rejected or over-protected the children, only one pre-schizophrenic S was judged to be ambivalent towards the parents; the rest were accepting. Friedlander concluded that since maladjustment was found to continually increase in the majority of the schizophrenic portion of the sample, the position that schizophrenia is the end result of progressive maladjustive habit reactions was supported.

Birren (1944) found 38 persons who had been referred to a child guidance clinic for "backwardness" in school work. Of these, 15 were later diagnosed as schizophrenic. Birren found that the mean IQ of the pre-schizophrenic Ss, although below average (mean: 88.2) was significantly higher than the control group of Ss. Further, in the test situation they tended to be more apathetic, which Birren interpreted as a mode of adjustment related to later withdrawal.

It is interesting that Birren's figures on mean IQ of pre-schizophrenic Ss (88.2) are similar to figures gathered by Lane and her co-workers twenty years later (Lane & Albee, 1962; Reuter, Albee & Lane, 1962). These investigators reported on Cleveland school children tested individually (Lane & Albee, 1963) or as part of the normal school testing program (Lane & Albee, 1962; Reuter et al, 1962). For 124 pre-schizophrenic Ss given two individual IQ tests, the mean dropped from 81.1 on the first to 69.7 on the second (approximately four years later). For 29 who were given two paper-and-pencil tests, there was a drop from 96.6 to 86.7 on the second administration. The drops were significant within both groups; a control group of Ss showed no drop from their mean score of 100. Compared to their own classmates, the pre-schizophrenic Ss had significantly lower IQ scores (Reuter et al, 1962). Further, the difference was found even when pre-schizophrenic Ss were compared with their own sibs (Lane & Albee, 1962).

Thus, from the above reviewed research, it appears that pre-schizophrenic individuals are distinctly different from normal controls. They test lower in intellectual function; they tend to be more aggressive; they have more diffuse social-self concepts, and come from friction-laden homes. Furthermore, these differences increase over time. There is

some reason, therefore, for supposing that other variables such as reactivity to stress might also differentiate pre-schizophrenic persons from controls.

Research with Children of Schizophrenic Parents

Aside from enumerational studies done by psychiatric-genetic investigators, there have been only a few reports of studies using children of schizophrenic parents, and these findings are not consistent. Fish & Alpert (1962) examined children born to schizophrenic females who were hospitalized at the time. For the 13 infants followed (10-24 months) the median measures of arousal, ability to maintain attention, amount of crying, and time continuously alert were not different from normal standards (Gesell & Amatruda, 1945). However, four infants were different primarily in their ability to maintain a state of quiet, open-eyed alertness as early as thirteen hours of age. In addition, one infant was excessively irritable through and beyond the second year. The authors concluded that these deviations, which occurred as early as the first day of life, provided evidence of an inherited nervous system dysfunction in schizophrenia.

However, when Sussex, Gassman & Raffel (1962, 1963) examined 16 children of ten non-hospitalized schizophrenic mothers, they found relatively stable functioning among all; six showed potential adjustment problems, and four were quite passive. On a psychiatric rating scale, however, none were in the range of psychotics or those with behavior disorders. Those with the lowest rated adjustment scores were children whose mothers had most recently become ill. The authors concluded that as a group the children didn't show marked evidence of being adversely affected by their mother's illness.

The contribution of environmental and hereditary factors to schizophrenia was studied by Sobel (1961) using a particularly ingenious design. Sobel found eight couples all of which were schizophrenic according to Kallman's diagnostic standards; the female member of each couple was pregnant. The genetic literature suggested that five of the eight resulting children would eventually become schizophrenic. By coincidence, four children were placed in foster homes, and four remained with their mothers. Sobel found that of the four who remained with their biological mothers, three showed "clear-cut signs of emotional disorders in infancy" (p. 513). None of the four raised in foster environments showed such abnormalities. The three affected children showed depression, excessive irritability, and tearfulness. Two of these were placed in foster homes, and at 2 1/2 years of age seemed to be moving along the lines of healthy personality development. Sobel explained his results primarily in terms of environmental effects on the emerging personality of the children. A preliminary report (Grunebaum & Weiss, 1963) indicated no adverse effect on children being raised by hospitalized schizophrenic mothers.

Psychophysiological Measure of Reactivity

The assumption that anxiety is identified with heightened cortical arousal in response to stressful stimuli finds support in the recent literature. Thus, Malmo (1957) has concluded from a series of experiments that anxiety may be defined as behavioral and physiological arousal. Berlyne (1960), after reviewing some of the recent data, concluded that "what are usually called emotional states are, it seems, states of high arousal" (p. 48). Thus, anxiety may be defined as heightened arousal in response to stressful

stimuli. Further, since the stimulus used in this experiment was described by the Ss as "anxiety-provoking," "scary," "fearsome," and "annoying" or in similar terms, the responses to this stimulus can be reasonably assumed to be an indicant of the anxiety provoked.

As mentioned earlier, skin resistance was used as the response measure in this experiment. Skin resistance was chosen because it is one of the most widely used psychophysiological measures of emotion and arousal. The resistance of the skin has been presumed to be a function of the amount of sweat secreted, which in turn was related to the activity of the autonomic nervous system (Lindsley, 1951; Darrow, 1934; Richter & Levine, 1937). However, a recent experiment has indicated that the relationship between skin resistance changes and sweating is correlational; there was no evidence that the latter caused the former (Wilcott, 1962). Rather, both may be controlled by some central mechanism. It is likely that this mechanism may be central arousal, for lowered skin resistance is associated with heightened arousal, and presumably with anxiety (Kleitman, 1939; Richter, 1926; Venables & Wing, 1962).

Furthermore, skin resistance measures have the advantage of being continuously recorded, so that precise measures of change can be tabulated. In addition, recovery time and latency of response are easily obtainable. For this experiment, it was decided to use skin resistance, rather than some conversion of it (such as, for example, conductance). Before presenting a review of the literature on skin resistance and GSR among schizophrenic Ss, it is appropriate to mention the orienting response as it relates to reactivity.

The orienting response is defined as behavioral orientation towards any new stimulus, and it is accompanied

by specific physiological responses. Recently, the Russian research literature has contained references to the orienting response (the chtoe takoe or "what-is-it" reflex). A summary of some experiments (Voronin & Sokolov, 1958) indicated that when an unexpected mild stimulus is presented to humans there is heightened EEG activity, skin resistance changes, and other changes associated with heightened arousal occur. It is important to differentiate the orienting response from changes connected with anxiety. Primarily, the orienting response is selectively characterized by the mildness and novelty of the stimuli which evoke it and the particular pattern of autonomic and somatic responses (Lynn, 1963). The stressful stimulus used in the present experiment was selected to minimize the orienting response. However, to assess the possible contribution of the orienting response to skin resistance measures, the effect of "neutral" tones was compared with the effect of the stressful stimulus.

Skin Resistance Research with Schizophrenic Ss

The research literature on skin resistance in schizophrenic individuals is large and somewhat inconsistent. Very early studies by Richter (1926; 1928), McCowan (1926) and Syz (1926) reported generally lower levels of skin resistance for their schizophrenic Ss than for normals. Peterson & Jung (1907) and Odëgaard (1933) reported that schizophrenic Ss had higher than normal skin resistance levels (i.e., less aroused than normal). None of these studies quantified the data in accordance with the canons of modern experimental methods, and information concerning age, sex, and duration of hospitalization is notably lacking.

Psychological stress. Studies using auditory stimuli to elicit changes in skin resistance have been reported by

Shipley (1934) and Mays (1934), who apparently reported on different aspects of the same data. Catatonic schizophrenic Ss adapted less in response to the stimuli during the first session than did the normal control Ss (Mays, 1934); they also gave more responses and showed greater reactivity during the second session than did the controls (Shipley, 1934).

Williams (1953) presented three different kinds of stress (impersonal, personal, and interpersonal) situations to schizophrenic and control Ss. The experimental group had been hospitalized from one to three years, and they had the same age and sex distribution as the controls. The schizophrenic Ss initially had significantly lower basal skin resistance than did the control Ss; however, their responses to the stress situations were not significantly different from those of the control Ss.

Jurko, Jost & Hill (1952) used the Rosenzweig Picture Frustration Test as stress stimuli in testing "early paranoid" schizophrenic, neurotic, and normal Ss. Their schizophrenic group showed greater recovery during a pretest period, less response to stress, but less total recovery following stress than the other groups. The greater pre-stress recovery is at variance with the assumptions of the learning theory approach outlined previously, and difficult to reconcile with their finding of less recovery following stress.

The only study of skin resistance in schizophrenic Ss differentiated on the basis of process-reactive ratings was reported by DeVault (1955). DeVault used only chronic Ss, and took the precaution of having two experimental sessions, using the first as a desensitization session. The stimuli consisted of cards depicting various scenes judged

hostile, neutral, sexual, and "dependent," a verbal warning, and a loud noise. The basal skin resistance for all groups was not different. The reactive schizophrenic Ss were similar to normal Ss in their responses; however, the process schizophrenic Ss manifested less response to stress than either group. In addition, the reactive Ss took significantly longer to recover than the normal or process subjects.

The stimuli used by Zahn, Rosenthal & Lawlor (1962) were so mild that they could not be considered stressful; accordingly, the authors termed their investigation a study of orienting responses. The arousal level of their 52 schizophrenic Ss, as measured by basal skin resistance, was significantly higher than for the 20 normal control Ss. Further, compared to the controls, their experimental Ss manifested greater responsivity to the stimuli (weak light; moderate tone) and took longer to habituate to them.

Freeman & Pathman (1943) reported no differences between their schizophrenic and normal Ss in either basal level or responsivity to various grades of stress stimuli (pistol shot, questions, free-association). No data on recovery were included.

In summary, two studies reported higher than normal reactivity to stress, two reported lower than normal reactivity to stress, and two reported no differences between their schizophrenic and control Ss; thus the evidence from these studies on reactivity to stress in schizophrenics is equivocal. On the other hand, recovery is apparently abnormally slow in schizophrenic Ss, as assumed by the theory.

Physical stress. Three studies of responsivity of schizophrenic Ss to physical stress are worth noting. Malmo & Shagass (1949) reported no differences in the reactions of schizophrenic and normal Ss to heat applied to the forehead.

Ax, Beckett, Cohen, Frohman, Tourney & Gottlieb (1961) reported greater than normal reactivity among schizophrenic Ss to pain. Howe (1958), using mild electric shock as a UCS, reported lower magnitude of conditioned GSR response. Both Ax et al. and Howe reported mean resting skin resistance levels as lower for their schizophrenic Ss than for the normal group; Malmo & Shagass reported there were no differences in initial arousal. It is interesting that whereas Howe found recovery (i.e., extinction) to be abnormally fast in schizophrenic Ss, Ax et al. reported their experimental Ss took abnormally long to lower their basal levels over several test sessions (i.e., long extinction).

The inconsistency of these results may lie in sampling or methodological differences between the various experiments. The use of the process-reactive dimension as a way of defining the populations may reduce disparity in the results of future research, as may the more rigorous segregation of populations according to length of illness. In the more recent experiments reviewed above, with more rigorous methodology, there appears to be a trend towards reporting schizophrenic Ss to be either more anxious initially, or more responsive to stimuli.

Hypotheses of the Experiment

Primary hypotheses. As stated, the purpose of this experiment is to test the assumptions implicit in many psychodynamic theories of schizophrenia and explicit in the drive-centered anxiety theory proposed by Mednick (1958). The experimental group (E) will be compared with the control group (C) to test the following hypotheses, which form the major investigation problem. The 5% level of significance will be used throughout, and parametric statistics used

wherever possible.

Hypothesis 1. In two samples of Ss whose primary distinction is their probability of becoming schizophrenic, the group with high risk of becoming schizophrenic will manifest significantly greater reactivity to anxiety-provoking stress.

Hypothesis 2. Group E will take longer to return to basal skin resistance levels following stress; group E will manifest less recovery (in amount) than group C.

Hypothesis 3. The basal skin resistance of group E will be significantly lower than the level for group C at various points throughout the testing session, and group E will recover less during a rest period preceding the UCS trials.

Hypothesis 4. GSR responsiveness is not a function of the orienting response; there will be no differential responding to the neutral CS desensitizing trials between the groups.

Secondary hypotheses. These hypotheses are derived from a consideration of the process-reactive dimension. The hypotheses related to mental health adjustment level assume that present adjustment level is related to later adjustment level; specifically those Ss with the poorest rated current mental health are the most likely to develop schizophrenia at some later date, while those with the best current mental health are least likely.

Hypothesis 5. Those experimental Ss rated as process-like (EP) will be significantly less reactive to stress than those rated as reactive-like (ER).

Hypothesis 6. Subgroup ER will be significantly more reactive than subgroup CR. No prediction is made comparing subgroup EP to group C.

Hypothesis 7. Subgroups ER and EP will take longer to recover than subgroups CR and CP, but will not be different from each other.

Hypothesis 8. Group E Ss rated as in poor mental

health (EB) will be significantly more reactive to stress than those rated as in good mental health (EG).

Hypothesis 9. Subgroup EB will be significantly more reactive to the UCS than those in subgroup CB. No prediction is made concerning group EG in relation to group C.

Hypothesis 10. Both group EG and EB will take longer to recover from stress than subgroups CG and CB.

METHOD

Procedure

There were two experimenters present during the session; one was a Danish psychologist,[1] who answered questions and assisted the writer, who acted as experimenter. The experimenters did not know, until the end of the testing day, whether the S was experimental or control. The procedure was identical for all Ss. The author participated in the project until September, 1963, when a second experimenter replaced him. A four-week training period preceded the change, thus insuring that procedural changes would be minimal.

Before the S arrived, the equipment was checked, calibrated, and activated. Temperature and humidity were noted, and the tapes to be used for presenting the stimuli were selected.

When the S arrived, he was escorted into the psychophysiological laboratory. No explanation was given other than that the procedure would not be painful, nor would blood be drawn (this was an almost universal question of the Ss). The S was then asked to lie on a hospital bed and to relax. The skin resistance electrodes were then attached.

The electrodes were fastened to the second and third finger pads of the left hand, after each finger had been sponged with alcohol. (The transducers for the other measures were also attached at this time.) The polygraph was

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[1]Appreciation is expressed to Mogens Kyng, PhD., for his assistance during the sessions.

activated, and the subject asked to close his eyes and relax for 15 minutes. During this period skin resistance was continuously recorded. At the end of the rest period, earphones were placed on the S. The tape recorder was started approximately 30 seconds later, as the E recorded the event on the record. Approximately 30 seconds after the tape recorder started, the instructions began. The instructions, in Danish, told the S that the session was beginning, and he should lie still and relax. The instructions continued by saying that physiological variables were being recorded, and that the subject would hear a loud, unpleasant noise. They ended with another admonishment to lie still and relax. When the instructions were finished, a 70 second pause ensued, and the test period began. The exact sequence is described in the materials section below. After the test period, the S was disconnected from the apparatus and escorted from the psychophysiology laboratory. The entire testing period took approximately 50 minutes, and always took place in the morning. The photo in Figure 1 gives a picture of the position of E, S, and the apparatus in the laboratory.

Noise and light were constant and minimal throughout. The psychophysiological laboratory occupied a two-room suite in the basement of the Copenhagen Municipal Hospital, off a little-used corridor. Signs cautioned quiet during the testing session. Temperature remained relatively constant throughout.

Apparatus

An Offner-Beckman Type R Dynagraph was used to record skin resistance (as well as the other physiological responses). A special Wheatstone skin resistance bridge was constructed



Fig. 1. Experimental arrangement

for the project. The bridge polarity and battery polarity were reversed every 1.2 seconds according to a relay-switching device described by Ax & Zacharopoulos (1962). This prevented polarization of electrodes. Input was processed from the bridge to the pre-amplifier via a straight-through coupler. Recording was through high-sensitivity ink-pen writers.

The skin resistance electrodes were two zinc plates 7 mm. in diameter, recessed in circular plastic cups 9 mm. in diameter, at a depth of 6 mm. Sponges impregnated with a weak zinc-sulfate solution served as the electrolytic contact. The electrodes were fastened to the Ss' index and ring fingers with adhesive tape. Residual resistance was checked daily, and new electrodes substituted in instances where the level went above 500 ohms. Calibration was facilitated by the use of a standard 10^5 ohm resistor built into the Wheatstone bridge. External calibration was done periodically using a decade resistance box.

The S heard the instructions and all standard stimuli through medium-sensitivity earphones. Standard presentation was assured by pre-recording the entire sequence on one track of a stereo tape. The third track was used to activate the event-marker on the polygraph; onset and offset of stimuli were thus recorded on the polygraph record at precisely the same time S heard them. The tapes were played through a Roberts Model 900 Stereo tape recorder.

One aim of the project was assessing ease of conditionability of the Ss. Thus, both neutral stimuli (CS) and stressful stimuli (UCS) were presented singly and in combination. The neutral tone was a pure tone of 1000 CPS. The stressful UCS was a very loud, unpleasant noise which lasted 4.5 seconds. The measured intensity of the CS was

54 db (reference point = .0002 dynes/cm.^{2}), while the intensity of the stressful stimulus was 96 db. (Normal conversation is about 60 db.)

Materials

The stimuli were presented on tapes prepared in the laboratory. The sequence on each tape was similar, except for the order of presentation of the generalization test tones (which came after the UCS trials). The sequence was as follows:

1. Instructions.
2. Seventy seconds pause.
3. Eight CS desensitization tones. The CS was presented for 2 seconds on the average (range: 1.5-3.0 seconds), with a mean intertrial interval of 7.5 seconds (range 5-11 seconds).
4. Conditioning trials. This consisted of 9 CS-UCS combinations and 5 CS trials. The order was as follows: CS-UCS_1, CS_1, CS-UCS_2, CS-UCS_3, CS_2, CS_3, CS-UCS_4, CS-UCS_5, CS-UCS_6, CS-UCS_7, CS_5, CS-UCS_8, CS-UCS_9. On trials where a CS-UCS combination was presented the CS had a duration of .5 seconds, while the CS was presented for 2.0 seconds on trials where the UCS was not given. The intertrial interval averaged 45 seconds (range: 17-77 seconds).
5. A three minute no-stimulus rest period.
6. Conditioning and generalization test trials. Nine trials comprising 3 CS trials, 3 $generalization_1$ tone trials (1311 CPS) and 3 $generalization_2$ trials (1967 CPS). Six different orders of presentation were used to balance for extinction effects.

Differentiation of Subgroups

The subgroups were formed by ratings obtained from two scales constructed by the writer. The first was the Process-Reactive Rating Scale and is given in Table 1 below. The scale contains ten items drawn from the psychiatrist's

TABLE 1

THE PROCESS-REACTIVE RATING SCALE

Item	Source	Scoring	Suggested By
Rarely asks questions;takes no part in discussions; is quiet and isolated	School Report	yes--0 no --1	Kantor et al. (1953)
Rarely takes initiative; waits passively for instruction	School Report	yes--0 no --1	Kantor et al. (1953)
Rarely takes part in spontaneous activities; when asked to participate, stays away	School Report	yes--0 no --1	Becker (1955)
Often disturbs class with unusual behavior, laughter or something else	School Report	yes--0 no --1	Stevens & Astrup (1963)
Behavior is over-active, normal, passive	School Report	active-1 normal-1 passive-0	
Has difficulty in making friends; seems lonely and rejected	School Report	yes--0 no --0	Phillips (1953)
Uncomfortable and/or awkward in contacts with classmates	School Report	yes--0 no --1	Becker (1955)
Spare time spent alone, or with friends	Psychiat. Report	alone-0 with friends-1	Kantor et al. (1953)
Feels most comfortable when left to himself, in his own milieu	Psychiat. Report	true--0 false-1	Kantor et al. (1953)
Subject's home life has unusual amount of parental conflict	Psychiat. Report	true--0 false-1	Farina (1960)

interview and the teacher's report; the items were selected on the basis of criteria set forth in the research literature; Table 1 lists the source and the origin of the criteria. Items in which the description was more process-like were scored 0; those in which the more reactive-like direction was indicated were scored 1. The range of possible total rating scores was thus 0 to 10; the obtained range was 2.2 to 10. Subjects in the upper and lower fifth of the resulting continuum were used to obtain the subgroups. The number of Ss, and the mean score for each subgroup, are given in Table 2. The split-half reliability score, computed on a random sample of fifty Ss (corrected using the Spearman-Brown formula) was .51 (Freeman, 1955).

TABLE 2

MEAN SCORES AND NUMBER OF SUBJECTS IN THE PROCESS-REACTIVE SUBGROUPS

Group	Mean Score		Mean Score	
	Process	Reactive	Process	Reactive
Experimental	3.4	10.0	36	40
Control	4.8	10.0	18	20

The Ss were also divided into two subgroups on the basis of their current mental health adjustment ratings. A Current Mental Health Scale was constructed from ratings made by the psychiatrist who interviewed the Ss.[2] Items on the scale are presented in Table 3, along with the scores

[2]Appreciation is expressed to Dr. Fini Schulsinger, Chief of Psychiatry, Kommunehospitalet, for his aid.

TABLE 3

THE CURRENT MENTAL HEALTH SCALE

Items of the Scale	Scoring Standards
Did the subject manifest clear consciousness?	yes -- 2 prob.- 1 no -- 0
Was the subject coherent?	yes -- 2 prob.- 1 no -- 0
Was the subject oriented to his environment?	yes -- 2 prob.- 1 no -- 0
The subject's train of associations was:	normal -- 3 restrained-- 2 rapid -- 2 pathological-0
The subject's mood was:	normal -- 3 below norm.--2 above norm.--2 pathological-0
The subject's affect was:	normal -- 3 slight dev.--2 no affect -- 0 pathological-0
Did the subject manifest psychotic features in his behavior?	no -- 3 yes -- 0
The subject's degree of schizoid behavior was:	none -- 5 slight -- 4 some -- 3 much -- 2 schizoid- 1
The prognosis for this subject is:	good -- 5 fairly good -- 4 doubtful -- 2 relatively bad-1 poor -- 0

assigned. The range of possible scores was 1 to 28; the obtained range of scores was 10 to 28. The number of Ss and the mean ratings for the subgroups are given in Table 4. The split-half reliability coefficient for the scale, using a random sample of 65 Ss, was .81 (Spearman-Brown correction used, as suggested by Freeman, 1955).

TABLE 4

NUMBER OF SUBJECTS AND MEAN SCORES FOR THE CURRENT MENTAL HEALTH SCALE SUBGROUPS

Group	Mean Score		Number of Subjects*	
	Good (G)	Poor (P)	Good (G)	Poor (B)
Experimental	25.1	15.9	32	37
Control	27.3	22.2	19	33

*Total N = 121

Subjects

The Ss were 291 experimentally naive children and adolescents selected from the experimental pool of 311 total children who were tested. The 291 represented all the Ss who were tested when the GSR recording apparatus had been unquestionably functional, and when the session had continued without interruption or early termination. Five additional Ss were randomly discarded in order to balance cells for the purpose of the analysis of variance. The 194 experimental and 97 control Ss were individually matched for age, sex, social class, education, per cent of the group who had lived in children's homes, and place of residence. The means for groups E and C on these variables are summarized

in Table 5.

TABLE 5

MEAN CHARACTERISTICS OF THE EXPERIMENTAL AND CONTROL GROUPS

	Experimental	Control
Number of subjects	194	97
Males	105	54
Females	89	43
Mean age	15.0	15.2
Mean years of schooling	7.0	7.3
Mean social class rating	2.2	2.4
Percent of group in children's homes (five years)	16%	14%
Percent of group with rural residence	26%	22%

Social class was determined using criteria suggested by Svalastoga (1959). Dr. Svalastoga kindly adapted his system to correspond to the defining characteristics of the sample. The adaptation resulted in an eight-point scale ranging from 0 to 7. Class was relatively easy to code, since the judgement depended almost entirely on occupational title. In 60 cases a disagreement was found on only one case, and that by one class, when two trained judges rated them independently. Children who lived in children's homes were given a rating of zero in all cases.

The defining independent variable for the experimental

group was that all Ss were children of mothers who were, or had been, chronically ill with schizophrenia. To judge whether the mother could be so classified, two experienced Danish psychiatrists were trained together in making judgements from the hospital records. The agreement as to diagnosis in 20 test cases judged independently was 100%. They judged whether the mothers were "typical" (i.e., process) cases, and discarded any questionable ones. Following this reliability check, only one psychiatrist (Dr. Schulsinger) checked each record. As noted in the introduction, mothers were selected for several reasons: (a) psycho-developmentally they presumably play a greater role in shaping children; (b) the offspring of process schizophrenic women have a higher rate of schizophrenia (Schulz, 1939); (c) parentage was definitely established; and (d) schizophrenic women have more offspring than schizophrenic men.

None of the children in the control group had mothers who were, or had been, schizophrenic (nor had the father or any grandparent). All parents of control Ss were checked through the records of the Institute for Human Genetics in Copenhagen. Neither group contained any Ss with neurological diseases or hearing difficulties.

Scoring

Several Danish psychology students aided in the scoring. The writer directed the team and assembled scoring standards in consultation with the project director and team members. To be scored as a response, a GSR had to occur within five seconds of the stimulus, and represent at least 5% of the basal skin resistance level. Reliability checks were performed periodically, and errors occurred with approximately the same frequency as the reliability limits of the apparatus (5%).

RESULTS

The theoretical orientation of this study led to the hypotheses that group E, with the high risk of becoming schizophrenic, would manifest greater reactivity to the stress created by the experimental situation; greater reactivity to the UCS presentations; and slower recovery following each UCS than group C. In addition, it was hypothesized that those Ss in group E rated as more reactive-like (subgroup ER) on the Process-Reactive Rating Scale would react more strongly than those rated as more process-like (EP); that both these subgroups would take longer to recover than the corresponding group C subgroups (CR and CP). Finally, it was hypothesized that those Ss in group E rated as having poor current mental health (subgroup EB) would react more strongly and would take longer to recover than those in the corresponding group C subgroup (CB); no prediction was made concerning those Ss rated as good in their current mental health adjustment (subgroup EG).

The first section of this chapter is concerned with comparisons between group E and group C. The basal resistance level, responses on desensitization trials, responses to the UCS, and time to recovery will be presented in that order. In addition, response latency data will also be presented. For convenience, the variances for all measures are included in Appendix A, which also gives the F tests of homogeneity performed on the variances. The basal resistance level was sampled at various times throughout the session; at each time point it was averaged over Ss in each of the

two groups. The mean GSR amplitude--in ohms--was used as the response measure on the desensitization tone trials and on the UCS trials; basal skin resistance immediately preceding the stimulus was used as a covariance control. Amount of recovery was measured by the mean amount of recovery in skin resistance (following the peak of response) during the intertrial interval. Recovery rate was measured by the time required for skin resistance to return to the pre-stimulus level following the GSR. For example, if the pre-stimulus skin resistance was 120,000 ohms, the response amplitude was 20,000 ohms, and the skin resistance returned to 110,000 ohms during the intertrial interval, then the amount of recovery was 10,000 ohms. The time to full recovery would be the entire intertrial interval; the rate of recovery was measured by determining the recovery time and controlling for response size. Latency was measured from the time of stimulus onset. The arrangement of the data on the IBM cards was not amenable to analyses across trials, or this would have been done.

Similar comparisons of the process-reactive subgroups and the mental health subgroups are presented in succeeding sections. Significance of the differences in response measures was assessed by analysis of variance[3] and by *t* tests of individual cell means (when the interaction terms were significant). The comparisons involving the whole groups *E* and *C* were two-dimensional while those involving the subgroups were three-dimensional. The statistical hypothesis of no difference between the means was rejected if the probability of such differences occurring by chances was equal to or less than .05.

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[3]Appreciation is expressed to Dr. James Lingoes for his aid in obtaining and modifying the analysis of variance program used.

The design of the experiment allowed the partialling out of variance attributable to age differences. Age groupings formed the second dimension on the primary group analyses, and the third dimension for the subgroup analyses. This use of age as an independent dimension was suggested by Lacey & Lacey (1962). They found that age differences contributed more to differences in psychophysiological results than sex differences. Therefore, since the ratio of males to females was roughly equal in the two primary groups, it was decided to control for the effect of age and not analyze sex. It is not the intention of this experiment to treat the results of age groupings; there were no significant interactions found in any of the primary analyses except for latency, and these interactions will be presented and subsequently discussed. There were some third-order interactions on individual trials on the subgroup analyses; however, they did not vary in any systematic way, and thus will not be discussed or interpreted.

Though we shall not treat age differences, a brief summary of them will be given here: The youngest Ss (of the three groups) had the lowest mean basal levels of skin resistance, and the middle age group had the largest GSRs to the UCS, followed by the oldest age group. These differences were consistent across trials, as can be seen in Table 6, which gives the basal skin resistance levels at selected points in the session and the mean GSR amplitudes to the UCS trials for the trials analyzed. The F ratios and levels of probability are also given in Table 6. There were no reliable age differences in the recovery data, and the only age differences for latency will be discussed in the main body of this chapter.

TABLE 6

AGE DIFFERENCES IN BASAL RESISTANCE LEVEL (OHMS) AT SELECTED POINTS AND IN MEAN GSR (OHMS) ACROSS TRIALS**

Period	Mean Skin Resistance			df	F-ratio	Prob.
	Age 1	Age 2	Age 3			
Beginning*	109,613	124,667	141,357	2/284	4.42	<.05
Middle of rest pd.*	116,880	139,000	160,620	2/305	7.72	<.01
End of rest*	137,307	181,946	203,662	2/284	8.77	<.01
First UCS Tr.	121,280	149,060	172,470	2/305	8.65	<.01
Fourth UCS trial	115,010	141,460	158,570	2/305	8.39	<.01
End of session*	140,009	154,133	179,671	2/284	7.95	<.01
UCS Trial	Mean GSR**			df	F-ratio	Prob.
	Age 1	Age 2	Age 3			
First	15,313	22,813	18,502	2/276	3.32	<.05
Third	6,374	9,402	7,253	2/280	3.41	<.05
Fifth	6,580	10,249	7,623	2/278	4.33	<.05
Seventh	5,324	8,002	5,644	2/282	2.05	>.05
Ninth	6,052	7,652	5,006	2/279	3.91	<.05

*Co-variance controlled for humidity.

**Co-variance controlled for basal skin resistance level.

Experimental-Control Group Analyses

Arousal level. The arousal level was assessed by the basal skin resistance level at several points throughout the session. The following points were selected and analyzed: the beginning of the session, the middle of the rest period, the end of the rest period, the point just preceding the first UCS trial, the point just preceding the fourth UCS trial, and the end of the session. The results of the analyses of variance of basal skin resistance at these points are summarized in Table 7. As indicated in the table, group

TABLE 7

MEAN BASAL SKIN RESISTANCE (OHMS)
AT SELECTED POINTS

Period	Mean Skin Resistance		df	F-ratio	Prob.
	Group E	Group C			
Beginning*	117,358	141,935	1/294	2.89	>.05
Middle of rest*	128,340	161,700	1/305	9.26	<.01
End of rest*	165,919	192,698	1/284	1.66	>.05
First UCS trial	140,860	163,180	1/305	4.28	<.05
Fourth UCS trial	131,150	154,410	1/305	6.19	<.01
End of session*	153,570	168,136	1/284	1.41	>.05

*Co-variance controlled for humidity.

E showed significantly higher skin resistance levels than did group C at points throughout the session. In view of this finding, it was decided to use basal skin resistance as a co-variance control on all further analyses of GSR amplitude. Two additional analyses were performed to determine whether there were any group differences in the rate of change in skin resistance level over the entire session. The basal level at the beginning of the session was used as co-variance control both for the level at the end of the rest period and for the level at the end of the session. As shown in Table 8 below, the rates of change for groups E and C were similar over the rest period, and over the entire session.

TABLE 8

MEAN CHANGES IN BASAL SKIN RESISTANCE FROM THE BEGINNING OF THE SESSION TO END OF REST PERIOD AND END OF SESSION*

Period	Mean Change		F-ratio	df	Prob.	Corr. with Co-Variate
	Group E	Group C				
End of Rest	+48,561	+50,723	3.63	1/284	>.05	+.58
End of Session	+36,212	+26,201	--**	1/284	>.05	+.41

*Co-variance controlled for initial level of skin resistance.

**F-ratio less than 1.00.

Responsiveness to neutral stimuli. The readiness of the Ss to respond to mild or neutral stimuli was assessed by comparing their GSRs on the desensitization tone trials, which were given before the UCS trials. The analyses were performed on GSR responses on the first and eighth desensitization trials. The level of skin resistance just preceding the stimulus onset was used as a co-variance control. As illustrated in Table 9 below, there were no significant differences between the groups in their responding to the neutral tones.

TABLE 9

MEAN GSR (OHMS) TO THE FIRST AND EIGHTH DESENSITIZATION TRIALS*

Desensitization Trial	Mean Response		Corr. with Co-variate	F-ratio	df
	Group E	Group C			
First	4,363	3,805	+.81	1.03	1/284
Eighth	444	158	+.12	2.76	1/284

*Co-variance controlled for basal skin resistance level.

Responsivity to the UCS trials. The major comparisons of concern in this experiment were those between the response of the two groups on the UCS trials. Five trials were picked for comparisons between the groups: the first, third, fifth, seventh, and ninth. The mean responses of groups E and C on these trials are presented in Table 10 below, along with the resulting F ratios, degrees of freedom, and probability levels. The degrees of freedom vary slightly,

TABLE 10

MEAN GSR (OHMS) ON THE FIRST, THIRD, SEVENTH AND NINTH UCS TRIALS*

UCS Trial	Mean Response		Corr. with Co-variate	df	F-ratio
	Group E	Group C			
First	22,726	11,031	+.33	1/276	33.37***
Third	8,757	5,448	+.24	1/280	17.03***
Fifth	9,392	5,571	+.23	1/278	17.58***
Seventh	7,308	4,260	+.16	1/282	7.77**
Ninth	6,693	5,204	+.10	1/279	3.27

*Co-variance controlled for basal skin resistance.

**Prob. less than .01.

***Prob. less than .001.

since they are based on the number of subjects on whom scoring was possible for that particular trial. The means include instances where no response was manifested, in which case a zero was scored.

On all trials, the experimental Ss were more responsive than the control Ss, and significant group differences were found on all trials save the last. The striking parallel between groups E and C in their rate of habituation over the session is illustrated in Figure 2 below, which shows the mean GSR amplitude of groups E and C as a function of trials.

Thus, to summarize, compared to group C, group E was more aroused initially and throughout the session. In

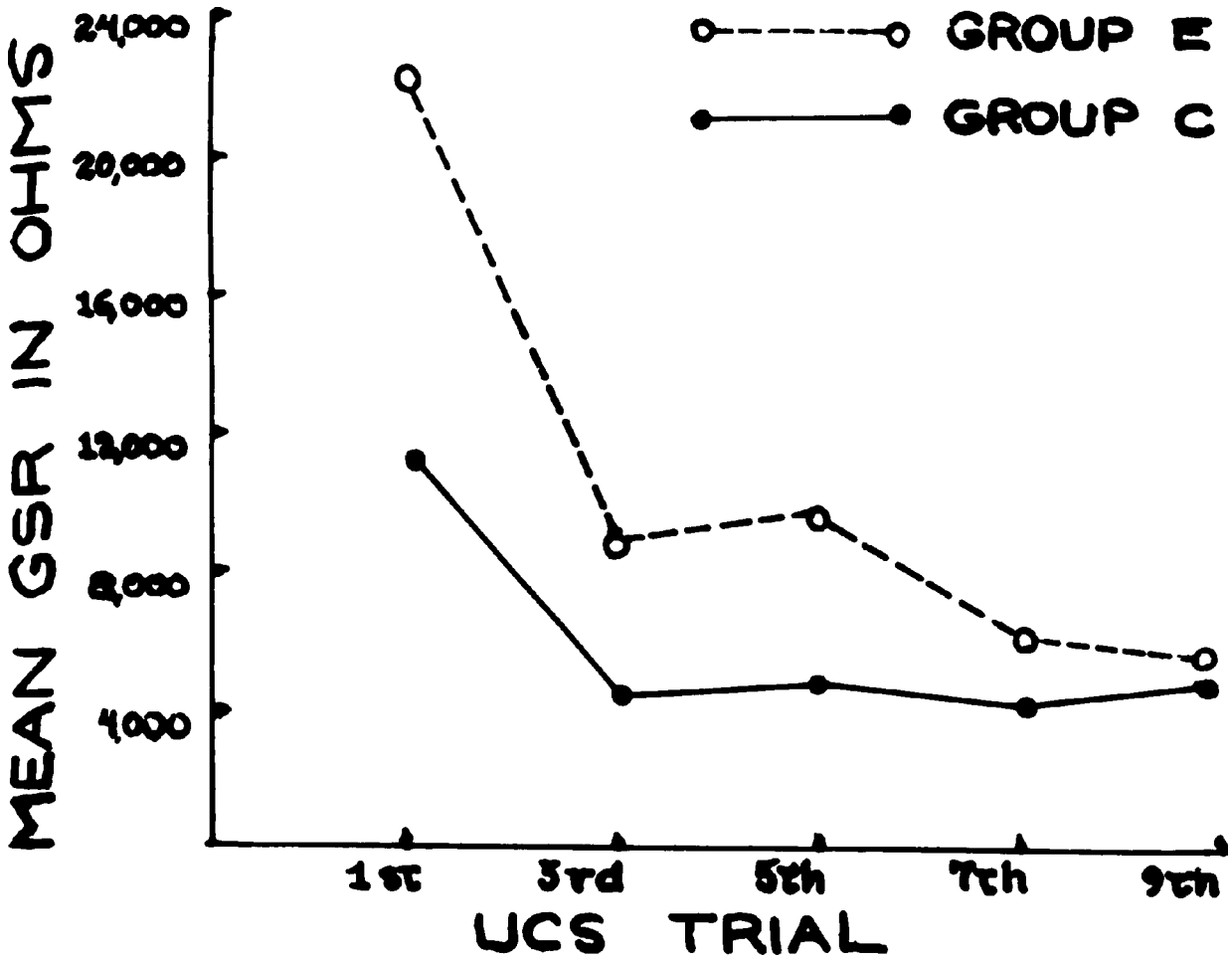


Fig. 2. Mean GSR of Groups E and C across trials.

addition, group E was more reactive to the UCS, but not more reactive than group C to the desensitization tones.

Recovery. Recovery from stress was measured in two ways: (1) by comparing the amount of recovery between the groups on each trial and (2) by comparing the rate of recovery of the two groups. As defined above, the rate of recovery was measured from the response peak to the point where the pre-stimulus skin resistance level was reached; in cases in which complete recovery did not occur, the intertrial interval was arbitrarily used as the recovery time. GSR amplitude was used as a co-variance control, for it was assumed that other things being equal, a larger GSR would take longer to recover than a smaller GSR.

For analyses of the amount of recovery, GSR amplitude was also used as a co-variance control, on the assumption that larger GSRs would tend to slow the amount of recovery that could occur in a given time period. Over-all, the measure was not very illuminating, for after the first trial the majority of Ss recovered completely, and there was little difference between the groups. Table 11 gives the amount of recovery and the F ratios of the differences for groups E and C, as well as the correlation between the amount of recovery and the size of the response. As Table 11 shows, there were no significant group differences.

The means in Table 11 are higher than the response means reported in Table 9 because the recovery means were computed on the basis of scorable responses only. Instances where an individual did not respond (response = 0) were excluded.

Significant group differences did appear in the rate of recovery. As shown in Table 12, group E took reliably

TABLE 11

MEAN AMOUNT OF RECOVERY (OHMS) ON THE FIRST, THIRD, FIFTH, SEVENTH AND NINTH UCS TRIALS*

UCS Trial	Mean Recovery		Corr. with GSR Size	df	F-ratio	Prob.
	Group E	Group C				
First	14,106	9,611	+.15	1/264	3.50	>.05
Third	9,239	6,821	+.81	1/238	1.44	>.05
Fifth	10,164	6,810	+.95	1/230	--	>.05
Seventh	9,895	7,215	+.97	1/194	--	>.05
Ninth	9,373	7,697	+.97	1/215	--	>.05

*Co-variance controlled for GSR size.

TABLE 12

MEAN RECOVERY TIME (IN SECONDS) ON THE FIRST, THIRD, FIFTH, SEVENTH, AND NINTH TRIALS*

UCS Trial	Mean Recovery Time		Corr. with Co-variate	df	F-ratio
	Group E	Group C			
First	62.43	64.47	+.74	1/267	1.43
Third	21.12	22.82	+.20	1/238	4.93**
Fifth	29.02	33.02	+.28	1/230	7.65***
Seventh	24.55	23.81	+.12	1/194	--
Ninth	35.76	42.41	+.29	1/215	4.18**

*Co-variance controlled for GSR size.

**Prob. less than .05.

***Prob. less than .01.

less time to return to the just-preceding basal level than did group C on the third, fifth and ninth trials, and the direction of the group differences was the same on the first trial. However, the direction of the difference was reversed on the seventh trial. Perusal of the data failed to reveal any reason for this reversal.

Thus, compared to group C, group E responded more to the UCS, but recovered more quickly. These findings suggested that the groups differ in response lability. Accordingly, response latencies (time from stimulus onset to beginning of response) on UCS trials were analyzed. The results are partially summarized in Table 13, which shows the mean latency (in seconds) for groups E and C across ages. The major finding in Table 13 is that on every UCS trial group E responded significantly more rapidly than did group C.

TABLE 13

MEAN RESPONSE LATENCY (IN SECONDS) ON THE FIRST, THIRD, FIFTH, SEVENTH AND NINTH UCS TRIALS

UCS Trial	Mean Latency		df	F-ratio	Prob.
	Group E	Group C			
First	1.87	2.29	1/267	10.°	<.01
Third	1.69	2.17	1/238	11.92	<.01
Fifth	1.75	2.39	1/230	26.44	<.001*
Seventh	1.73	2.15	1/194	9.25	<.01
Ninth	1.61	2.39	1/215	30.89	<.001*

*Significant interaction with age.

Age level, not included in this table, interacted with the main dimension on the fifth and ninth trials. In general, as the trials continued, the older group E Ss responded more rapidly, while the older group C Ss responded more slowly. The relationship is illustrated in Figure 3 below. Individual t tests performed (as suggested by Lindquist, 1953) on the cell means showed that the oldest group E Ss differed significantly from the corresponding group C Ss on trial five, but not on trial nine; there were no other significant t ratios between the subgroups.

By way of summary, the primary group analysis showed that group E had higher basal skin resistance levels than group C; in addition, in comparison to group C, group E had greater mean GSR amplitude on the UCS trials, tended to recover more rapidly, and had more rapid response latencies.

Process-Reactive Subgroup Comparisons

Groups E and C were divided into subgroups of those classified as more process-like (EP and CP) in their rated functioning, and those rated as more reactive-like (ER and CR). This section will report the results of the analyses done to determine the significance of the subgroup differences in responding.

GSR amplitude on UCS trials. As in the earlier analyses, GSRs of the subgroups on the first, third, fifth, seventh and ninth UCS trials were compared with each other. There were no significant differences between the process and reactive subgroups, nor were there any significant interactions between process-reactive and E-C treatments. Table 14 shows the mean responding for the total Process and Reactive (P and R) groups across the other dimension (E and C), as well as the means for subgroups EP, ER, CP and CR. The F ratios

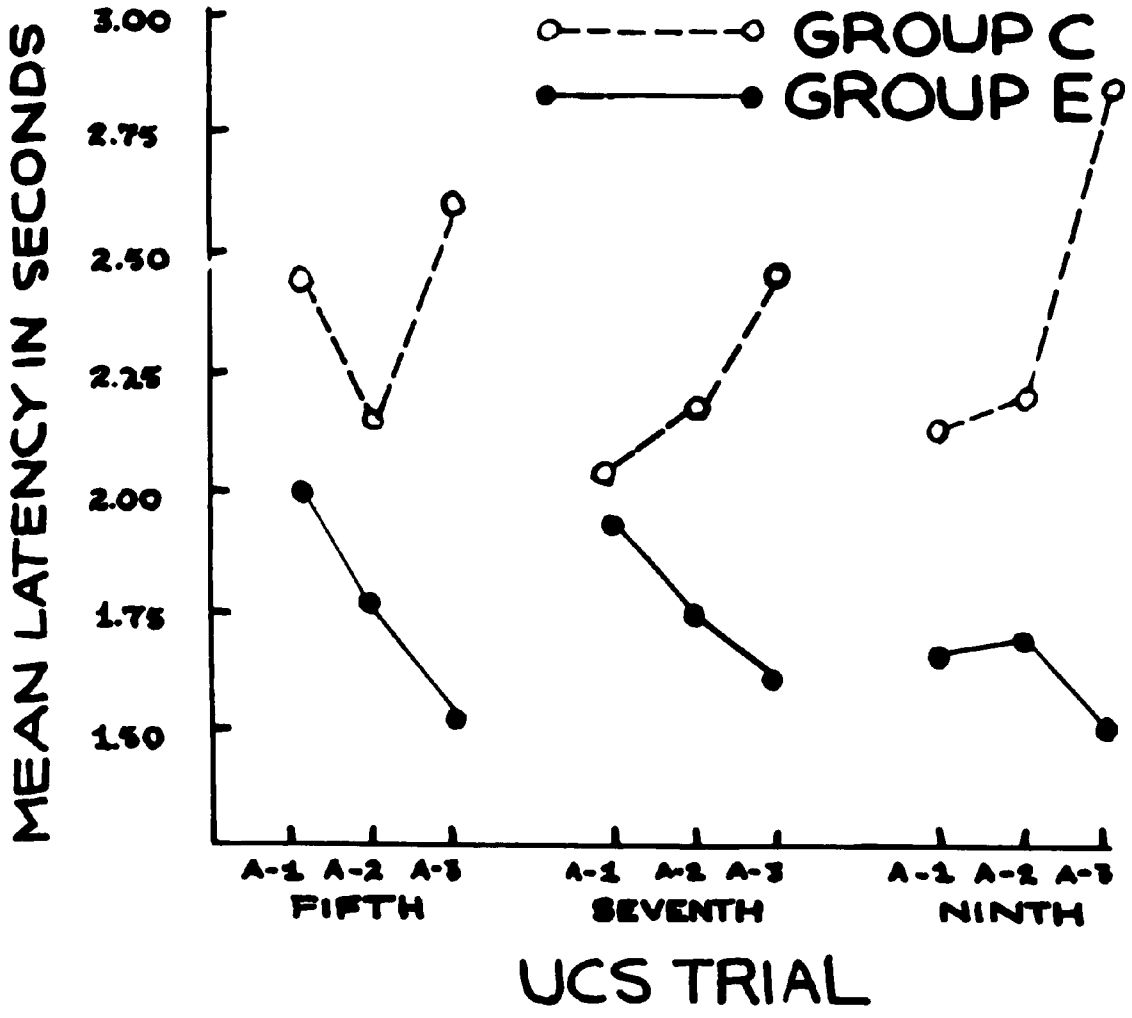


Fig. 3. Mean latency of groups E and C by age levels for the fifth, seventh and ninth UCS trials.

are not included in Table 14, for in only one case did the F ratio exceed 1.00, and in that one instance it was less than 1.5. It is apparent that the differences between groups E and C were sustained: the main effects for that dimension were significant on all trials but the ninth.

TABLE 14

MEAN GSR (OHMS) OF GROUPS P AND R, AND SUBGROUPS EP, ER, CP AND CR ON THE FIRST, THIRD, FIFTH, SEVENTH, AND NINTH UCS TRIALS*

UCS Trial	Mean GSR					
	Group P	Group R	EP	CP	ER	CR
First	18,278	19,859	22,602	9,629	24,438	10,700
Third	7,776	8,592	9,512	4,305	9,993	5,724
Fifth	6,879	7,502	7,760	5,119	8,519	5,467
Seventh	6,554	6,144	8,526	2,610	7,971	2,490
Ninth	5,898	6,870	6,107	5,481	7,838	4,933

*Co-variance controlled for basal skin resistance.

Recovery. The process and reactive subgroups did not differ significantly in the amount of recovery following GSRs. None of the comparisons across main effects or between subgroups were significant for any of the trials analyzed. Table 15 lists the mean recovery for the subgroups; the F ratios are not given, for again, none of them approached significance.

The results of an analysis of rate of recovery did not show any consistent differences between the process and reactive subgroups. The only significant differences were found on the third trial, on which groups P and R were

TABLE 15

MEAN AMOUNT OF RECOVERY (OHMS) FOR SUBGROUPS EP, CP, ER, AND CR ON THE FIRST, THIRD, FIFTH, SEVENTH, AND NINTH UCS TRIALS*

UCS Trial	Mean Amount Recovery			
	EP	CP	ER	CR
First	15,045	6,267	15,483	7,257
Third	10,202	5,262	9,681	5,824
Fifth	9,345	5,138	8,171	6,219
Seventh	11,533	4,214	10,650	4,967
Ninth	8,667	8,609	9,482	6,557

*Co-variance controlled for GSR size.

significantly different, and on the seventh trial, on which the P-R times E-C interaction was significant. The mean time (in seconds) to full recovery for the P and R groups, as well as subgroups EP, ER, CP and CR is shown in Table 16. It is evident that, in general, the process-reactive classification did not distinguish the groups, except on the third and seventh trial. When individual subgroups were compared with each other by means of t tests, none of the differences reached significance at the .05 level, even when the means were adjusted for the effect of GSR size.

Latency. Response latencies of groups P and R were not significantly different. However, on the third and fifth trials, significant interactions between the E-C and P-R treatments were found. There were no significant main effects. The subgroup latencies across trials are given in Table 17. The interaction between the E-C and P-R treatments is illustrated in Figure 4, which shows the subgroup

TABLE 16

MEAN RECOVERY TIME (IN SECONDS) FOR GROUPS P AND R, AND SUBGROUPS ER, EP, CR, AND CP ON THE FIRST, THIRD, FIFTH, SEVENTH, AND NINTH UCS TRIALS*

UCS Trial	Mean Time to Recovery					
	Group P	Group R	EP	ER	CP	CR
First	62.66	65.27	62.1	63.8	63.9	67.9
Third	19.28[1]	24.03[1]	18.1	21.6	23.3	25.5
Fifth	31.54	28.54	27.0	40.6	28.2	29.2
Seventh	24.45	24.78	23.7[2]	28.7[2]	25.8[2]	16.6[2]
Ninth	34.11	35.29	29.0	44.4	35.0	35.8

*GSR size used as co-variance control.

[1]F-ratio = 8.78, P < .01

[2]F-ratio = 4.69, P < .05

TABLE 17

MEAN RESPONSE LATENCY (IN SECONDS) FOR SUBGROUPS EP, ER, CP, AND CR ON THE FIRST, THIRD, FIFTH, SEVENTH AND NINTH UCS TRIALS*

UCS Trial	Mean GSR Latencies					
	Group P	Group R	EP	ER	CP	CR
First	3.33	3.23	3.0	3.1	3.7	3.9
Third	1.85	2.00	1.6*	2.6*	2.0*	2.1*
Fifth	2.01	1.81	2.0**	1.5**	1.9**	2.4**
Seventh	1.84	1.86	1.6	2.2	1.8	2.0
Ninth	1.86	1.89	1.8	1.7	2.0	2.2

*F-ratio = 4.69, P < .05

**F-ratio = 6.38, P < .05

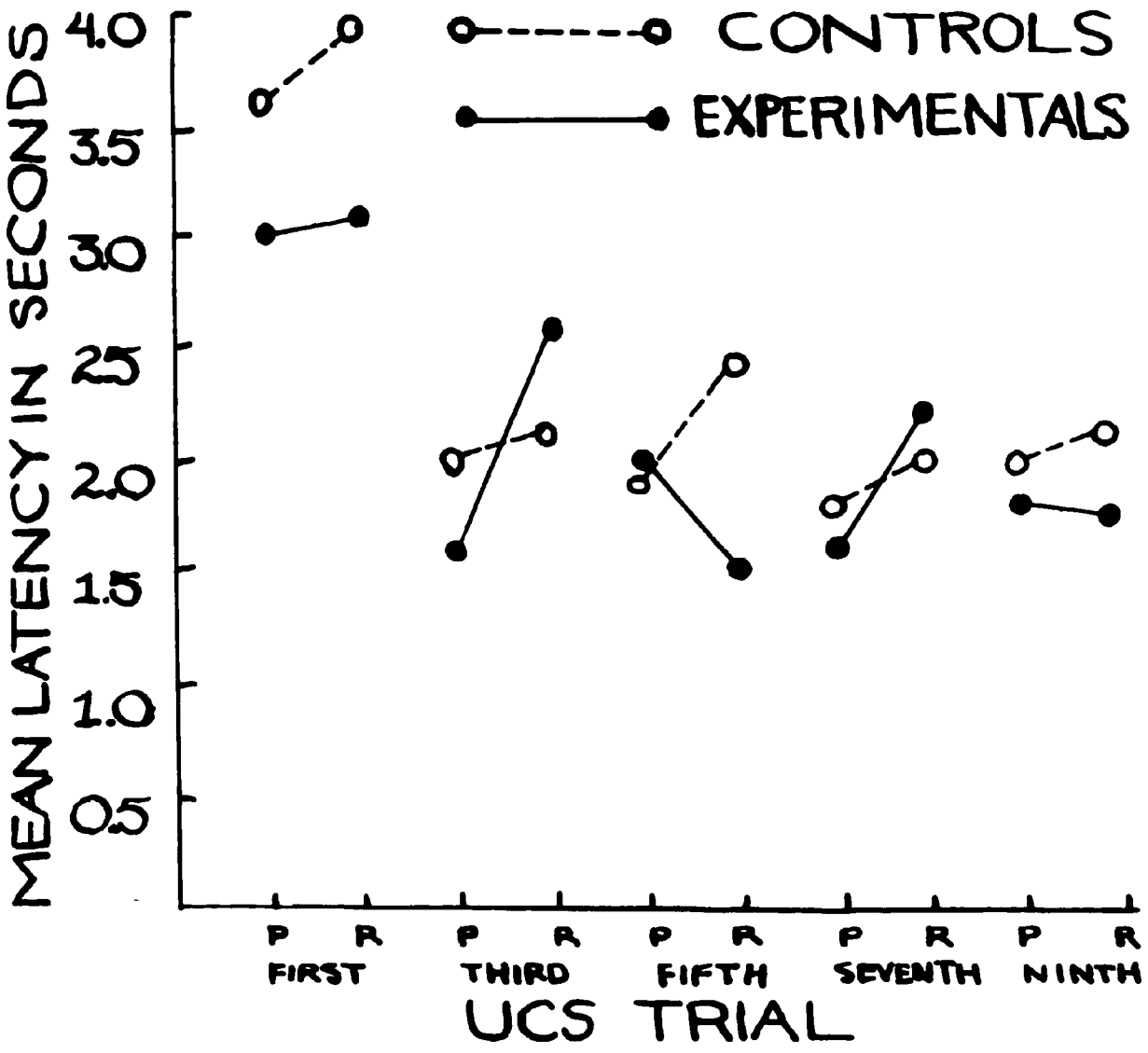


Fig. 4. Mean latency for subgroups EP, ER, CB and CR on the first, third, fifth, seventh and ninth UCS trials.

latencies across the trials. It is evident that subgroup EP responded more quickly throughout than subgroup ER, except on the fifth trial, where the relationship is reversed. Subgroup EP was almost always the faster in responding on the other trials.

Thus, the process-reactive classification did not differentiate the experimental Ss' GSRs, amount of recovery, or rate of recovery. There was a significant subgroup difference in rate of recovery only on one trial. Similarly, though interactions between the P-R and E-C treatments were present on trials five and seven when latency was considered, the relationship between the subgroups was not consistent; the exception was that on four of the five trials, subgroup EP responded most rapidly.

The lack of consistent, reliable differences between the process-reactive subgroups probably was due to the classification system used. Since reliability of the scale was quite low ($r = .51$), the validity of the classification is questionable. Thus, it was decided to construct a second scale based on current mental health ratings; it was hoped that this classification might more reliably differentiate the experimental Ss than did the process-reactive classification. To assess the degree of relationship between the two scales, a correlation was done on the two distributions of scores across Ss; the obtained Pierson r was +.06, which was not significant.

The Current Mental Health Scale
Subgroup Analyses

Responsivity to stress. The groups were divided according to their rating on the Current Mental Health Scale and classified as those in good mental health (subgroup EG

and CG) and those in poor current mental health (subgroups EB and CB). The analyses of their GSRs on the UCS trials revealed no significant differences between groups G and B on any of the UCS trials. However, there were significant interactions between the E-C and G-B treatments on three of the five trials analyzed; the direction of the differences was similar on the other two. As seen in Table 18, which gives the mean GSR responses over trials for the subgroups, those experimental Ss rated as poor in their mental health adjustment consistently responded more to the UCS stress than did any of the other subgroups. Figure 5 shows the mean responses of the four subgroups. The differences between the two experimental subgroups and the two control subgroups were assessed by means of t tests (Lindquist, 1953). The experimental subgroups were significantly different from each other only on the first trial ($t = 2.33$, $p < .05$).

TABLE 18

MEAN GSR (OHMS) OF SUBGROUPS EB, EG, CB, AND CG ACROSS THE FIRST, THIRD, FIFTH, SEVENTH AND NINTH UCS TRIALS[1]

UCS Trial	Mean GSR				G-B	E-C	Inter-action	
	EB	EG	CB	CG	F-ratio	F-ratio	F-ratio	df
First	26,667	17,880	8,007	13,137	--	32.19*	6.32**	1/106
Third	10,998	7,940	4,260	6,657	--	14.98*	3.82	1/107
Fifth	11,942	8,223	4,738	7,433	--	13.81*	4.58**	1/106
Seventh	9,771	7,810	5,967	8,443	--	2.05	1.13	1/107
Ninth	8,660	5,160	3,473	6,170	--	6.38**	5.17**	1/107

[1]Co-variance controlled for basal skin resistance.

*P < .01

**P < .05

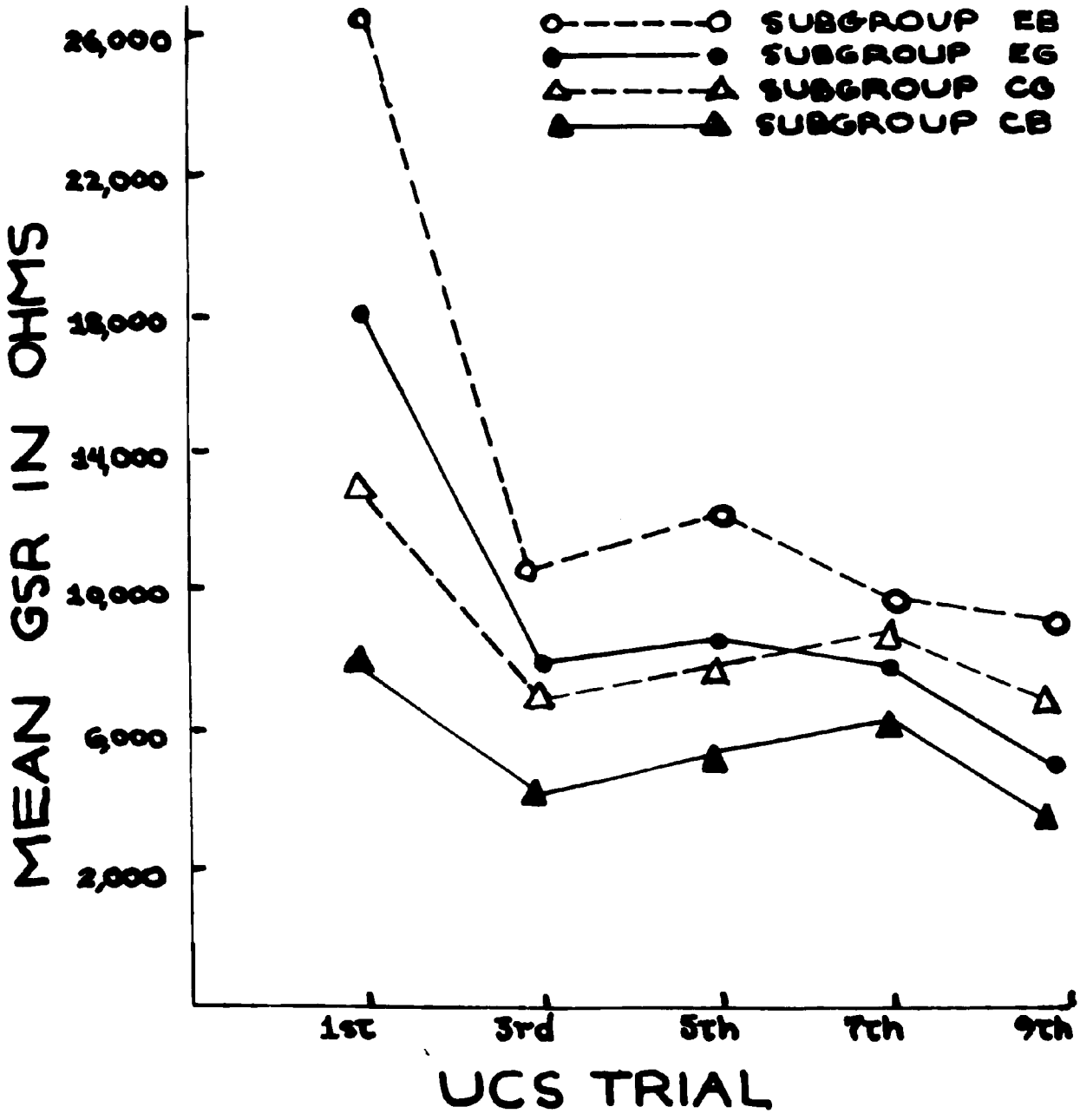


Fig. 5. Mean GSR of subgroups EB, EG, CB and CG in the first, third, fifth, seventh and ninth UCS trials.

Recovery. The amount of recovery did not differentiate between subgroups G and B. None of the analyses revealed any F ratios for main effects or interactions that approached significance. As before, GSR size was used as a co-variance control in these analyses.

However, the subgroups did differ in time to full recovery, although not on all trials (see table 19). There

TABLE 19

MEAN RECOVERY TIME (IN SECONDS) FOR GROUPS G AND B AND SUBGROUPS EG, EB, CG, AND CB ON THE FIRST, THIRD, FIFTH, SEVENTH, AND NINTH UCS TRIALS*

UCS Trial	Mean Recovery Time		df	F-ratio	Prob.
	Group G	Group B			
First	62.06	62.70	1/101	--	>.05
Third	24.26	19.39	1/96	8.51	<.01
Fifth	18.56	21.08	1/89	2.94	>.05
Seventh	25.76	24.05	1/71	--	>.05
Ninth	39.33	33.18	1/77	--	>.05

UCS Trial	Mean Recovery Time				df	Inter-Action F-ratio	Prob.
	EG	EB	CG	CB			
First	56.26	62.71	57.75	62.67	1/101	2.09	>.05
Third	21.00	17.80	27.53	20.99	1/96	--	>.05
Fifth	18.94	27.53	18.18	14.64	1/89	--	>.05
Seventh	20.37	25.83	31.15	22.38	1/71	4.01	<.05
Ninth	34.70	35.52	43.96	30.84	1/77	--	>.05

*Co-variance controlled for GSR size.

There was a significant difference between group G and B on the third trial, and a significant interaction between the E-C and G-B treatments on trial seven; the EB and CG subgroups took longest to recover. It is interesting that the only trial on which the process-reactive groups were different from each other in their rates of recovery was also the third trial.

Latency. There were no significant differences between the latencies of groups G and B on any of the trials. Table 20 presents the mean latencies of groups G and B across

TABLE 20

MEAN LATENCY (IN SECONDS) FOR GROUPS G AND B ON THE FIRST, THIRD, FIFTH, SEVENTH AND NINTH UCS TRIALS

UCS Trial	Mean Latency		df	F-ratio	Prob.
	Group G	Group B			
First	2.30	1.99	1/101	3.40	>.05
Third	2.03	2.03	1/96	--	>.05
Fifth	2.37	1.94	1/89	2.73	>.05
Seventh	2.06	1.75	1/71	2.92	>.05
Ninth	2.06	1.95	1/77	--	>.05

the other dimensions; though none of the differences were significant, there is a tendency of the group rated poorer to respond more rapidly than the other group. Comparing the latencies of subgroups, in Table 21 below, this tendency towards more rapid latencies appears to be due to the EB subgroup. None of the interaction F ratios, however, were significant at the .05 level, although they approached confidence on the fifth and seventh trials.

TABLE 21

MEAN LATENCY (IN SECONDS) FOR SUBGROUPS EB, EG, CB, AND CG ACROSS TRIALS

UCS Trial	Mean Latency				df	Interaction F-ratio	Prob.
	EB	EG	CB	CG			
First	1.61	2.02	2.38	2.58	1/101	1.31	>.05
Third	1.72	1.67	2.34	2.37	1/96	1.04	>.05
Fifth	1.56	1.98	2.33	2.49	1/89	3.74	>.05
Seventh	1.51	1.94	1.99	2.18	1/71	3.72	>.05
Ninth	1.55	1.46	2.35	2.66	1/77	--	>.05

In summary, with regard to GSR amplitude, subgroup EB had a significantly greater GSR than subgroup EG on trial one only. Subgroup CB and CG were not significantly different from each other on any trials. Subgroup EB had the largest GSRs on the other trials as well. Also, subgroup EB showed shorter latency responses than the other subgroups. Rate of recovery, however, revealed no consistent trends among the subgroups.

Summary of Results

Several consistent trends emerged from the results. As a whole, group E responded more rapidly, showed greater GSRs on the UCS trials, and recovered more rapidly than did group C. There were no group differences in responses to the neutral stimulus. Those experimental Ss rated as having the poorest current mental health adjustments gave the greatest GSRs to stress, and tended to respond the most rapidly, in comparison to the other subgroups. The process-reactive

classification as a whole did not prove fruitful: there were no consistent differences between the P and R subgroups across trials, although on individual trials differences between the subgroups were found in rate of recovery and latency.

DISCUSSION

The major findings reported in Chapter III were: In comparison with Group C, Group E showed higher basal arousal levels throughout the session, thus indicating they responded significantly more to the experimental situation itself. Group E responded more to the discrete UCS trials than group C, but not to the neutral desensitization tones; it took less time to recover from the UCS than group C; and it reacted more quickly than group C in response to the UCS. When the groups were divided according to the process-reactive distinction, there were no consistent differences between the subgroups. However when the groups were subdivided according to ratings of the adequacy of current personality functioning (Current Mental Health Scale), consistent differences emerged: subgroup EB was the most responsive of all subgroups, and significantly more so than subgroup EG on the first UCS trial; further, there was a non-significant trend showing subgroup EB to react the most quickly to the UCS. There were no subgroup differences in recovery data.

Primary Group Comparisons

The theoretical approach to schizophrenia presented in the Introduction stated that persons who become schizophrenic (1) have greater than normal anxiety responses to stress, and (2) have slower than normal recovery rates. The first hypothesis is supported by the results of this experiment: group E, whose members have a high risk of becoming schizophrenic, manifested greater GSRs on the UCS trials

throughout the conditioning period than did group C, which has a low probability of becoming schizophrenic.

In interpreting the overall reactivity of group E, two factors must be taken into account. First, their basal skin resistance level was higher than that of group C (Table 7). It has been argued that high basal levels of autonomic functioning (i.e., abnormally low resistance levels) tend to impose physiological "ceilings" which mask responses, such as GSR, to specific stress (Lacey, 1956). However, despite the abnormally low skin resistance levels of our experimental Ss (i.e., high arousal) they still showed GSRs of significantly greater amplitude to stress than did the control Ss. On the other hand, contrary to Lacey, it has been stated that GSR amplitude is positively correlated with basal skin resistance levels. In our data, however, it was group C which had the higher skin resistance levels and the lower GSR amplitude of the two groups. Thus, it cannot be argued that group E's higher GSR amplitude was due to higher basal skin resistance.

Another point to be taken into consideration is that group E did not react differentially on the neutral desensitization tone trials in comparison with group C, for the mean GSRs of the two groups were not significantly different. These results suggest that the pre-schizophrenic person over-reacts selectively to stimuli: those that are anxiety-producing cause heightened autonomic responses while those that are neutral have no effects. We shall return to this selectivity when discussing latency results.

Returning to the original hypotheses of the learning theory approach (Mednick, 1958), we will now take up the results of the analyses of recovery. While there were no

group differences in the amount of recovery, there were differences in the rate of recovery: group E consistently recovered more rapidly than group C, in spite of their generally greater mean GSRs. The differences were significant on three of the five trials on which recovery rates were analyzed (Table 13); the group differences on one of the other two trials were in the same direction. These findings are at variance not only with the theoretical assumptions presented here, but also with the results of previous research on already schizophrenic Ss (e.g., Ax et al., 1961; DeVault, 1955; Shipley, 1934; Whatmore & Ellis, 1958). The discrepancy between the data from this experiment and previous research may be due to the populations involved. Thus, as mentioned in the introduction, research on already schizophrenic populations is confounded by the effects of the illness itself, as well as the effects of hospitalization. For example, a person in the early stages of schizophrenia may be in a chronic state of heightened arousal (Arieti, 1955) which may, over time, permanently affect his autonomic functioning. Further, confinement within a hospital setting--where the orientation is often to calm patients rather than "cure" them--could quite possibly affect autonomic reactivity over a period of time. A replication of this experiment done with newly-admitted schizophrenic Ss (say, within the first 24 hours of hospitalization) might resolve the discrepancy between our recovery data and that of previous research on already-schizophrenic Ss.

With regard to the original postulates of the theory (Mednick, 1958) the assumption of abnormally slow recovery among schizophrenia-prone individuals was necessary for the derivation of the concept of "reciprocal augmentation."

Reciprocal augmentation, a hypothesized interaction of anxiety and anxiety-producing stimuli, was the construct used to explain why the pre-schizophrenic eventually turned to irrelevant thought sequences as anxiety-reducers; e.g., these thought sequences eventually became the only stimuli not more anxiety-arousing. However, since the pre-schizophrenic person appears to recover more rapidly than normal, rather than more slowly, there would be no chance for reciprocal augmentation to occur. Thus, to stay within the general learning theory framework, another explanation is needed to account for the learning of disordered thought processes. The following alternative outlines may be applicable.

It may be assumed that the pre-schizophrenic person recovers from stress more rapidly than normal. He would thus experience more rapid reinforcement for any behavior which followed recovery or aided it. There is a large body of research from general experimental sources (e.g., as reviewed by Deese, 1958) which shows that the more rapidly a drive-reducing event (e.g., reinforcement) follows a response, the more that behavior is reinforced. Thus, any behavior occurring in the recovery interval--particularly one which would contribute to recovery, such as escape--would be strengthened. In tension-arousing situations the most rapid behavior that can occur is some thought sequence; such a sequence would have to be quite unusual (e.g., remotely associated, irrelevant, idiosyncratic, or bizarre) to take a person's attention out of the situation. Occurring in such a context, the thought sequence would be reinforced more quickly than an analogous one which occurred to someone with a normal--e.g., slower--recovery rate.

Further, since the high-risk person is more aroused to begin with (as a consequence of his abnormally high reactivity to stress), the reduction in anxiety, and hence the reinforcement, is even greater. This would heighten the probability of it recurring, and eventually lead to learning these irrelevant, remotely-associated thought sequences (with or without idiosyncratic behavior, postures, etc.).

An alternative approach, which does not make quite as many assumptions, involves the disrupting effects of anxiety. Thus, the data of this experiment indicate the person with a high-risk of becoming schizophrenic is more than normally sensitive to stress stimuli. Such a person, in stressful situations, will tend to become abnormally anxious; high anxiety disrupts performance (Malmo, 1957) and it may very well disrupt thought processes. These disturbed thought sequences, occurring in association with the person's abnormally rapid recovery (anxiety-reduction) would be reinforced, and hence tend to be learned.

The primary difference between the two approaches outlined above is that in the first one the escape function of irrelevant thought sequences is stressed. It is closer to the conceptualizations of psychodynamic theories which hypothesize that schizophrenia is a regression from, or maladaptive attempt to escape, overwhelming anxiety (cf., Arieti, 1955; Fenichel, 1945; Searles, 1959). The second approach, however, is simpler and is closer to the known principles of behavior. Both hypotheses will have to be directly investigated before their tenability can be decided. However, the general assumption of both (that the pre-schizophrenic experiences abnormally rapid recovery from anxiety and during this rapid recovery experiences disrupted thought

sequences which are reinforced) does avoid a difficulty in the learning theory approach as it was originally postulated.

The original approach (Mednick, 1958) stressed that the pre-schizophrenic person takes longer than normal to recover, but that an irrelevant thought sequence is immediately reinforcing through anxiety-reduction. However, since recovery is presumably a measure of reduction of anxiety, it was difficult to conceive how a person could both experience immediate drive-reduction and take abnormally long to recover. Our data suggest that the pre-schizophrenic person recovers more quickly than normal, so that he can experience anxiety-reduction more rapidly than a low-risk person.

The GSR and recovery data suggested that group E's higher than normal autonomic lability might extend to response latency as well. This proved to be so; upon examination group E was found to respond significantly faster than group C on all UCS trials (Table 13, Figure 3). There is no relevant psychophysiological data on already schizophrenic Ss with which to compare this finding. However, our results are clearly not in accord with those descriptions of schizophrenia which posit that a basic parameter is "sluggish autonomic reactivity" (Gellhorn, 1953; Hoskins, 1946). Instead, the data suggest that the potentially schizophrenic person is selectively primed to respond to anxiety-producing stimuli. Silverman (1963) has hypothesized that the pre-schizophrenic person is continually alert to noxious stimuli, and tends to differentiate such stimuli faster than normal persons do. The latency data are congruent with such an hypothesis. Perhaps because the high-risk person consistently becomes more anxious in response to stress than the low-risk person, he gradually becomes more sensitive, or alert, to stress; this

sensitivity may be responsible for his more rapid response to stress. Another possibility is that the person's high arousal level promotes abnormally short latency responses.

Pre-Schizophrenic Psychophysiological Responding: Hypotheses

The primary group analyses lead to the following conclusions concerning the psychophysiological responding of pre-schizophrenic persons: persons with a high risk of becoming schizophrenic manifest greater anxiety reactivity than do low-risk persons, but do so selectively to noxious, anxiety-provoking stimuli. They are selectively alerted to such stimuli, and tend to react to them more quickly than do normal persons. They recover from the effects of anxiety-producing stimuli more rapidly than normal persons. It is further hypothesized, as suggested by the general framework of the learning theory approach (Mednick, 1958), that they experience more rapid reinforcement for behavior which follows anxiety increase, and that disrupted thought sequences are among the behaviors most likely to occur. In accord with Mednick's analysis (1961) it is hypothesized that recurrent exposure to anxiety-provoking stimulation, particularly within the context of a generally noxious situation, leads to the learning of these bizarre or disrupted thought sequences.

The Process-Reactive Subgroup Comparisons

It was hoped the Process-Reactive Rating Scale would add precision to the conclusions suggested by the primary group results. However, from the results, it is clear that the process-reactive ratings did not differentiate the experimental Ss with regard to GSR, rate of recovery, or latency of response in any consistent manner. Several possibilities

for explaining these negative findings suggest themselves; of these, the most reasonable explanation appears to be that the Process-Reactive Rating Scale did not, in fact, fulfill its function.

First, the scale could not include some prominently mentioned criteria for making the process-reactive distinction. Thus, it was impossible, because of lack of data, to rate: (1) degree of heterosexual contact (Kantor et al., 1953); (2) degree to which the father or mother was dominant in the household (Farina, 1960); (3) work history (Stevens & Astrub, 1963); and (4) degree of personal or environmental stress on the person (Phillips, 1953). Lacking these items (and others of perhaps less importance), the scale may have been inadequate in terms of the range of functioning covered by the items.

The lack of these items probably was responsible for the low reliability of the scale. The obtained range of scores was only from 2 to 10, and was thus probably not wide enough to meaningfully allow subgroups to be distinguished. Even after being corrected by use of the Spearman-Brown formula (Freeman, 1955), the coefficient was only +.51, which indicates the scale has unsatisfactory reliability. Lacking important items, and deficient in internal consistency, the scale may be considered as an inadequate instrument for delineating meaningful subgroups.

The other possibility for explaining the lack of significantly different results is that (even with adequate criteria) it would be impossible to meaningfully delineate psychophysiologically the process and reactive subgroups in a pre-morbid population. However, research has shown that a wide variety of differences between process and reactive

patients do emerge during the pre-morbid phase (cf., reviews by Higgins, 1964; Herron, 1962). Further, investigators working with already schizophrenic populations have found psychophysiological differences between process and reactive subgroups (e.g., DeVault, 1955; King, 1958; Zuckerman & Grosz, 1959). Therefore, it may well be possible to differentiate the psychophysiological responses of pre-process and pre-reactive schizophrenics, after a reliable way of scaling pre-morbid populations is achieved.

The Current Mental Health Subgroup Comparisons

The Current Mental Health Scale did differentiate the subgroups on the basis of their GSR amplitude. Those experimental Ss with the poorest current mental health ratings were the most reactive to stress. Further, they responded with greater mean GSRs than did group E as a whole on all UCS trials (as seen in Tables 9 and 18). It may be assumed that the EB Ss have the highest probability of becoming schizophrenic at some later date, on the basis of their current mental health. The heightened GSR of this subgroup, then, lends added support to the learning theory hypothesis: those individuals with the highest risk of becoming schizophrenic have the highest levels of anxiety responsiveness.

The logical alternative to the conclusion that members of subgroup EB have the highest risk of becoming schizophrenic is that they are more prone to all types of mental illness, and their high reactivity adds nothing to the correlation of high reactivity with later schizophrenia. It could be said that not only do they have a higher risk of becoming schizophrenic, but also a higher risk of becoming neurotic, psychosomatically ill, et cetera. At present this

is an open question, for there are no statistics readily available concerning the percentage of group E who will manifest other forms of psychopathology. Böök, in a recent review of the psychiatric-genetic literature (1960), stated that "it is important to note that the risk of other psychoses is not significantly increased for the relatives of schizophrenic patients." (p. 28) He gave no references on which he based this conclusion, however, and the author, after looking through several reports (Kallman, 1938; 1946; 1952) has been unable to find any mention of the probability of developing other illnesses than schizophrenia, given a schizophrenic parent.

Implications of the Present Experiment

The results of this experiment are provocative enough to warrant a good deal of further investigation. In the preceding sections of this chapter we have made some conceptual leaps which will necessitate a good deal of experimental confirmation before they can be considered firmly established. One question that has already been alluded to is why our results with a pre-morbid, high-risk population are so much at variance with much of the research on already schizophrenic populations. The prevailing stereotype of the schizophrenic person pictures the "typical" schizophrenic as a rigid, autonomically sluggish person who has difficulty in adapting to new situations. Our data suggest almost precisely the opposite picture of a person who is abnormally fast in psychophysiological responding, and hyper-reactive. Further, those who are poorest in their rated mental health functioning are the most hyper-reactive and possibly the most rapid responders. One possible answer to this discrepancy between our

findings and the "typical" picture of the schizophrenic may lie, as suggested earlier, in the discovering of the effects of hospitalization on the schizophrenic person. It would be worthwhile to test patients as soon as they are brought to the hospital--before they have been sedated, secluded, or tranquilized. Only then can the psychophysiological functioning in pre-morbid and morbid states be investigated. This is an area in which the author hopes to do further research in the near future.

Another avenue of research lies in the development of a reliable scale for rating a pre-morbid population along the process-reactive dimension. The author experimented with several alternative scales (using data available) which were even worse from the standpoint of reliability than the one finally used. Nevertheless, it seemed to the author that a reliable, valid instrument could be constructed given adequate information. However, for the future, the scale should be prepared before the Ss are seen, and should take into account the defining characteristics of the sample.

Of course, the present experiment demands a long-term follow-up, which is being planned at present. Since the investigation was carried out in Denmark, with its excellent record system, no difficulty is anticipated in maintaining contact with the Ss. When a group of Ss who have entered the hospital with a diagnosis of schizophrenia has been assembled, their psychophysiological response patterns will be compared to the rest of group E, and with group C. It is expected that the resulting patterns will be similar to those manifested by subgroup EB.

There is another possible approach which the present findings suggest with regard to further research. The results

of this experiment indicated a particular pattern of psychophysiological responding which, it is hypothesized, is characteristic of the pre-schizophrenic person. On the basis of these findings, it is possible to consider an experiment in which the psychophysiological pattern of response of a very large number of Ss would be the independent variable and various indices of psychological function would be the dependent variable. If the pattern characteristic of our high-risk group differentiated those Ss with the poorest psychological functioning and/or prognosis, the present conclusions would be strengthened. Further, a program of identification of potential pre-schizophrenic persons could be considered.

SUMMARY

This study was performed to test hypotheses concerning the etiology of schizophrenia using a pre-morbid population, which offers certain advantages over the use of already schizophrenic Ss in controlling for the effects of hospitalization. Specifically, the experiment was designed in order to test the assumptions of the learning theory approach to schizophrenia (Mednick, 1958). The theory assumes that the pre-schizophrenic person is different from the normal person along three basic dimensions: he becomes abnormally aroused by anxiety-provoking stimuli; he takes longer than normal to recover from such stress; and he has greater than normal generalization gradients. In the present experiment, the first two assumptions were tested.

Since studies have shown that children with one schizophrenic parent have a 14-16% chance of becoming schizophrenic themselves, offspring of chronically ill female schizophrenics were used as a high-risk pre-morbid group. Children of schizophrenic mothers were chosen for several reasons. These parents have more children than do male schizophrenics. Further, parentage would be firmly established; and psychodynamically mothers presumably exert a greater influence on their children than do fathers. The control Ss came from families none of whose members were schizophrenic for at least two generations. Group E and group C contained 194 and 97 Ss respectively, individually matched for age, education, social class, residence, and sex.

In light of the research on the process-reactive

dimension, it was decided to subdivide the groups according to their ratings on a Process-Reactive Rating Scale; in addition, a second subdivision was done using a Current Mental Health Scale rating. It was hoped that the process-reactive division would aid in interpreting the functioning of the groups.

The measure of anxiety-arousal chosen was skin resistance. Basal skin resistance was used because of its high correlation with central measures of arousal, and its convenience of measurement.

The experiment was part of a larger project done in Denmark at the Copenhagen Municipal Hospital's Psychological Institute. The apparatus used to record skin resistance and skin resistance changes was an Offner Type R Dynagraph. Part of the procedure involved a conditioning session in which the galvanic skin response to a very loud, unpleasant white noise (UCS) was conditioned to a 1000 CPS pure tone (CS). The S was escorted to the laboratory, connected to the electrodes, and given a fifteen minute rest period. Following this period, the S heard instructions, in Danish, telling him to lie still and relax; the instructions and all stimuli were conveyed through earphones. Following instructions, the S heard eight desensitization tones, and nine CS-UCS combinations (interspersed with five CS-alone trials). The psychophysiological variables (skin resistance, heart-rate, respiration, EMG) were continuously recorded. The session was always carried out in the morning, and took about 50 minutes over-all. Five of the UCS trials, and two of the pre-conditioning desensitization trials, were selected for analysis.

Major differences were found between groups E and C:

The experimental group was significantly more aroused at the beginning and at selected points throughout the conditioning period than group C. The experimental group manifested significantly greater mean GSRs on four of the five UCS trials than group C, and the direction of the differences was the same for the fifth trial. There were no group differences in amount of recovery, measured in ohms, but there were differences in the rate of recovery: the experimental group recovered significantly faster than the control group on the majority of the trials analyzed. Because this finding suggested greater autonomic lability in group E than group C, response latencies were also analyzed, and the experimental group was found to have responded more rapidly than the control group on all UCS trials. There were no differences between the two groups in their GSRs on the desensitization trials.

The process-reactive subgroup analyses yielded little in the way of reliable differences. Failure of the Process-Reactive Rating Scale to differentiate the subgroups was tentatively attributed to the lack of several important items in the scale, and its low reliability. The Current Mental Health Ratings, however, did differentiate the GSRs of the experimental Ss. Subgroup EB, with the poorest rated mental health, consistently responded with the greatest mean GSRs to stress. In addition, this subgroup was consistently the quickest to respond, though none of the differences were significant.

These results were discussed in terms of their potential significance for understanding the functioning of preschizophrenic persons. The greater anxiety-responsiveness of the high-risk group in comparison with the low-risk group was interpreted as support for the learning theory approach.

A modification to the theory as it was originally proposed (Mednick, 1958) was developed to account for the recovery data. It was hypothesized that the more rapid recovery of group E compared to group C following anxiety-arousal would provide greater reinforcement for any behavior which occurred during, or facilitated recovery. It was argued that the most rapid behavior that can occur in an arousing situation is a thought-sequence, and that some irrelevant, remotely-associated, or idiosyncratic thought sequence would be most reinforcing. This approach has been treated more extensively in a recent article by Mednick (Mednick & Schulsinger, in press).

The mental health subgroup differences were interpreted as adding further support to the learning theory position that persons with a high risk of becoming schizophrenic are abnormally reactive to stress.

The study holds potentially important implications for the future. However, it is recognized that a great deal of experimental confirmation of these conclusions is needed. Several avenues for future research were suggested, including follow-up of the present sample. The author would like to investigate the relationship between the present findings and psychophysiological responding among incipient schizophrenic persons.

APPENDIX A

GROUP VARIANCES

VARIANCES OF GROUPS E AND C: BASAL SKIN RESISTANCE AT SELECTED POINTS DURING THE SESSION

Period	Variances		F-ratio	Prob.
	Group E	Group C		
Initial level	5,111,538,800	7,220,530,000	1.41	>.05
Middle of rest period	5,810,725,000	11,912,471,000	2.05	>.05
End of rest period	14,481,248,000	20,307,053,000	1.40	>.05
First UCS trial	7,684,752,000	11,347,896,000	1.48	>.05
Fourth UCS trial	5,370,455,200	9,157,475,500	1.70	>.05
End of session	12,070,024,000	14,969,817,600	1.24	>.05

VARIANCES OF GROUPS E AND C: GSR ACROSS UCS AND DESENSITIZATION TRIALS

UCS Trials	Variances		F-ratio	Pub.
	Group E	Group C		
First	585,521,300	79,150,300	7.40	<.01
Third	417,278,000	34,733,700	12.01	<.01
Fifth	102,211,670	37,058,200	2.76	>.05
Seventh	98,641,700	87,013,200	1.34	>.05
Ninth	58,111,000	42,239,000	1.38	>.05
Desensitization Trials	Variances		F-ratio	Pub.
	Group E	Group C		
First	30,885,400	34,681,600	1.12	>.05
Eighth	3,522,300	2,034,100	1.73	>.05

VARIANCES OF GROUPS E AND C: RECOVERY TIME AND AMOUNT OF RECOVERY

UCS Trial	Recovery Time Variances		F-ratio	Prob.
	Group E	Group C		
First	1,068	1,054	1.01	>.05
Third	430	442	1.03	>.05
Fifth	1,432	1,479	1.03	>.05
Seventh	1,148	1,105	1.04	>.05
Ninth	6,931	6,237	1.11	>.05
UCS Trials	**Amount of Recovery Variances**		**F-ratio**	**Prob.**
	Group E	**Group C**		
First	188,667,800	457,478,600	2.43	>.05
Third	65,315,600	92,008,400	1.41	>.05
Fifth	80,055,000	33,761,100	2.37	>.05
Seventh	54,846,500	85,430,100	1.56	>.05
Ninth	144,393,000	80,643,100	1.79	>.05

VARIANCES OF GROUPS E AND G: LATENCY

UCS Trial	Variances		F-ratio	Prob.
	Group E	Group C		
First	4.52	3.21	1.41	>.05
Third	5.31	4.69	1.13	>.05
Fifth	4.31	4.98	1.05	>.05
Seventh	5.33	8.33	1.19	>.05
Ninth	4.08	4.92	1.21	>.05

VARIANCES OF SUBGROUPS EP, ER, CP, AND CR:
GSR ACROSS UCS TRIALS

UCS Trial	Variances				F-ratio[1]	Prob.
	EP	ER	CP	CR		
First	505,308,910	572,229,120	68,456,910	51,500,500	11.11	<.01
Third	131,128,280	72,248,990	25,997,810	34,604,500	5.61	<.05
Fifth	128,879,070	93,134,260	45,400,160	23,366,820	5.52	<.05
Seventh	229,644,080	77,495,560	60,606,400	93,036,950	3.79	>.05
Ninth	92,212,000	75,032,000	56,497,500	84,066,300	1.63	>.05

[1]Based on most disparate pair.

VARIANCES OF SUBGROUPS EP, ER, CP, CR:
RECOVERY TIME AND AMOUNT OF RECOVERY

UCS Trials	Recovery Time Variances				F-ratio[1]	Prob.
	EP	ER	CP	CR		
First	1,091	1,062	1,040	614	1.77	>.05
Third	414	492	420	313	1.57	>.05
Fifth	1,235	1,314	1,396	1,354	1.13	>.05
Seventh	943	1,529	1,382	790	1.94	>.05
Ninth	2,867	4,485	5,834	3,063	2.03	>.05

UCS Trial	Amount of Recovery Variances				F-ratio[1]	Prob.
	EP	ER	CP	CR		
First	762,966,200	674,389,500	1,450,093,100	382,684,100	3.79	>.05
Third	106,883,200	50,009,400	26,539,100	31,524,700	4.03	<.05
Fifth	136,257,400	80,285,600	33,604,500	22,434,700	6.07	<.05
Seventh	420,172,500	103,176,000	8,608,700	17,379,000	48.81	<.01
Ninth	81,701,400	49,331,200	67,848,900	42,482,600	1.92	>.05

[1]Based on most disparate pair.

VARIANCES OF SUBGROUPS EP, ER, CP, CR: LATENCY

UCS Trial	Variances				F-ratio	Prob.
	EP	ER	CP	CR		
First	5.88	4.26	3.33	3.30	1.78	>.05
Third	4.20	2.92	5.24	4.29	1.79	>.05
Fifth	6.00	3.41	7.22	2.27	3.18	>.05
Seventh	6.77	4.38	3.35	5.08	1.72	>.05
Ninth	3.71	3.94	3.82	4.27	1.15	>.05

VARIANCES OF SUBGROUPS EB, EG, CB, AND CG:
GSR ACROSS UCS TRIALS

UCS Trial	Variances				F-ratio[1]	Prob.
	EB	EG	CB	CG		
First	556,260,130	370,454,060	53,465,120	97,355,910	10.38	<.01
Third	144,185,330	88,751,450	19,854,030	42,709,910	7.26	<.01
Fifth	134,146,060	139,042,540	32,430,600	39,634,000	3.98	>.05
Seventh	110,529,800	236,486,440	135,917,500	61,520,000	3.84	>.05
Ninth	39,835,200	82,139,330	57,459,760	60,506,500	2.06	>.05

[1]Based on most disparate pair.

VARIANCES OF SUBGROUPS EB, EG, CB, AND CG:
RECOVERY TIME AND AMOUNT OF RECOVERY

UCS Trial	Recovery Time Variances				F-ratio[1]	Prob.
	EB	EG	CB	CG		
First	964	1,863	1,316	707	2.64	>.05
Third	383	513	592	305	2.89	>.05
Fifth	1,639	1,414	1,572	1,608	1.16	>.05
Seventh	1,094	1,046	948	1,741	1.84	>.05
Ninth	4,795	9,709	5,099	5,161	2.02	>.05
UCS Trial	Amount of Recovery Variances				F-ratio[1]	Prob.
	EB	EG	CB	CG		
First	264,803,630	629,549,370	841,871,460	468,282,280	3.18	>.05
Third	141,987,930	78,424,390	20,607,120	282,343,570	13.70	<.01
Fifth	132,683,210	56,857,360	28,724,330	28,183,310	4.71	<.05
Seventh	93,639,510	184,201,580	196,603,650	32,949,170	5.97	<.05
Ninth	438,143,383	65,695,370	36,963,460	29,672,650	14.77	<.01

[1]Based on most disparate pair.

VARIANCES OF SUBGROUPS EB, EG, CB, CG: LATENCY

UCS Trial	Variances				F-ratio[1]	Prob.
	EB	EG	CB	CG		
First	6.23	4.61	1.68	2.80	3.70	>.05
Third	8.55	3.16	4.72	4.12	2.71	>.05
Fifth	4.31	7.14	3.34	3.37	2.14	>.05
Seventh	4.72	4.86	5.01	4.85	1.06	>.05
Ninth	4.14	3.47	4.40	12.59	3.63	>.05

[1]Based on most disparate pair.

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