ROTARY PURSUIT PERFORMANCE IN REACTIVE AND PROCESS SCHIZOPHRENICS

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This is to certify that the

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M. Ray Denny
Major professor

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ROTARY PURSUIT PERFORMANCE IN REACTIVE AND PROCESS SCHIZOPHRENICS

BY

Walter Otis Smith

AN ABSTRACT

Submitted to the School for Advanced Graduate Studies of Michigan State University of Agriculture and Applied Science in partial fulfillment of the requirements for the degree of

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ABSTRACT

The present study was concerned with obtaining an objective description of the adaptive responses of process and reactive schizophrenics in a motor learning situation. Performance on a pursuit rotor task was chosen as a convenient method of accomplishing this purpose.

A process schizophrenic is best described as having an early and insidious onset of psychosis with a relative absence of precipitating stress. Typically, he has had an inadequate prepsychotic personality. He shows a tendency to avoid interpersonal contacts and presents a clinical picture of flat affect and a relative absence of confusion.

A reactive schizophrenic, on the other hand, is one with a relatively abrupt and stormy onset of psychosis, usually attributable to a logical and significant stress situation. The prepsychotic personality has been normal or neurotic, rather than schizoid, with perhaps some degree of outgoingness. The clinical picture following the psychotic break is likely to include severe confusion and many affective components.

In the present investigation, Becker's modification of the Elgin Prognostic Scale was utilized for selection of process and reactive schizophrenics from the schizophrenic population of a Veterans Administration neuropsychiatric hospital. All schizophrenic patients who had been diagnosed as psychotic for less than one year were rated on Becker's scale, and these ratings were found to approximate a normal curve. Subjects in the upper and lower tails of the distribution were classified as process and reactive respectively.

Each of the psychotic classes so selected was divided into four groups with 10 subjects in each group. Pairs of groups (10 subjects from each psychotic class) were then assigned to four conditions of spacing and massing of practice while learning the rotary pursuit task. Massed practice (M) was defined as continuous practice throughout a practice period, and distributed practice (D) was defined as alternating 30 seconds practice and 30 seconds rest. The four conditions of practice were M-M-M, M-D-M, D-D-M, and D-M-M. The first practice period consisted of six minutes of practice for all subjects, the second of nine minutes, and the third of three. The third and final period was massed for all subjects. Two five-minute rest periods separated the three practice periods.

Comparisons between process and reactive patients were made on the bases of time on target, temporary inhibition, conditioned inhibition, warm-up decrement, and time taken to regain set after a rest.

It was found that no significant differences existed among the eight groups at the beginning of practice in the first practice period nor during the entire final period during which all subjects practiced under massed conditions. Thus it is strongly indicated that differences in psychomotor ability or in learning were not the effective factors in bringing about differences in performance.

During the other phases of testing, differences which showed a high degree of consistency with each other were

obtained. Statistical treatment of the data provided considerable assurance that these differences did not arise by chance.

The chief findings with respect to process schizophrenics were: They took longer to adapt themselves and enter into the task. After a rest, they also took longer to regain their set and warm up in resuming practice. When continued under the same conditions for successive practice periods, they progressively improved in performance. When shifted from spaced conditions to the relatively more demanding massed conditions, however, their performance was disrupted.

These results were interpreted as indicating that process schizophrenics were hesitant in initiating new activities and prone to withdraw when thwarted. In other words, they avoided a threatening external situation by withdrawing from activity. Supportive evidence for this interpretation is found in studies of "chronic" schizophrenia and in the few reported studies that have made use of the process-reactive concept.

Findings regarding reactive schizophrenics were largely in the opposite direction. They entered into the novel situation more quickly and took a shorter time to regain set after a rest. When continued for successive periods under the relatively undemanding spaced conditions of practice, their performance deteriorated. On the other hand, performance continued to improve with successive periods of massed practice. When conditions of spacing and massing were shifted in either direction, these patients showed relative improvement in

performance.

These results were interpreted as evidence that reactive schizophrenics avoided their internal environments by a flight into activity. Then, when increasing skill rendered the easier task less effective as an escape device, satiation set in quickly. Any change in the task, even to more noxious conditions, was therefore reacted to positively.

Some supportive evidence for this interpretation is found in the literature on "acute" or "early" schizophrenia as well as in studies of process and reactive schizophrenia.

In summary, it was concluded that process and reactive schizophrenics demonstrated some real differences in their responses to the rotary pursuit task, and that these performance differences could best be explained as arising from differing habitual modes of adjusting. These results are viewed as possibly having important implications for prognosis and therapy of schizophrenic patients.

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INTRODUCTION

Schizophrenia

Every student of psychopathology knows or soon learns that we are indebted to Emil Kraeplin for his grouping into one psychological entity the varied forms of what is today (at least in the United States) called schizophrenia. The name which Kraeplin applied in 1896, dementia praecox, was borrowed from the French psychiatrist Morel. Kraeplin, however, used the term in a different sense than did Morel and is thus to be credited with the concept in its present meaning (15). Under the classification of dementia praecox, Kraeplin subsumed mental disorders which had been known and described previously but which had been regarded as separate clinical entities. He still, however, divided the patients into three sub-groups: the hebephrenic, the catatonic, and the paranoid. Later, he accepted as belonging in the same category a fourth type (the simple) which was suggested by Bleuler (24). Among these apparently dissimilar cases, Kraeplin was able to discern common characteristics, the most outstanding and most important of which was a progressive tendency toward a state of dementia. Using this as the primary criterion, he found he could differentiate from other illnesses and define as dementia praecox a syndrome also including incongrous affectivity, negativism, impairment of attention, stereotyped behavior, hallucinations, and delusions in the presence of a relatively well preserved

orientation in time, space, and personal identity. He also separated from the dementia praecox group a new nosological entity which he called "paraphrenia". Here, as in dementia praecox, the outcome of the disease was the fundamental consideration since a patient with paraphrenia suffered no decay of the personality. As to etiology, Kraeplin thought of dementia praecox as an endogenous illness. At first he thought it was due to some organic pathology of the brain. Later, he stated that it might be due to a metabolic disorder.

It becomes apparent, then, that almost from the time he introduced the concept of dementia praecox, Kraeplin himself began to be concerned about the questions that have plagued theorists and investigators ever since. The great merit of identifying relationships and consistencies among the diverse symptomatologies is self-evident. On the other hand, the very process of grouping involves a danger of ignoring or concealing differences by putting all cases under one blanket as it were. First, as Kraeplin himself came to recognize, not all cases of dementia praecox meet even the original criterion of ending in dementia. Some cases stabilize at a less severe level, and some even seem to make complete recoveries. In the second place, not all cases begin early in life, and, third, not all cases that deteriorate progressively do so precipitously (21, 24, 26, 43, 44, 53, 111, 113, 118). Thus it became increasingly evident that the term dementia praecox could not appropriately be applied to

the illness, and that some fundamental changes in the concept were needed. Additional difficulties arose from Kraeplin's method of attack. The finalistic method of making or changing a diagnosis on the basis of the outcome of the disease is not compatible with a scientific search for the causes rather than the effects. Associated with this was Kraeplin's confining himself to a purely descriptive approach, always cross-sectional in nature even though the concept itself entailed a process rather than a specific state.

For these, and perhaps other reasons, Kraeplin's contributions met with considerable opposition. Eugene Bleuler (24), however, accepted many of the Kraeplinian concepts, and he revised and revitalized them by an attempt to go beyond the purely descriptive level. He advocated the term "schizophrenia", implying that a splitting of the various psychic functions was outstanding among the symptoms which he saw as fundamental to the disease and so present to some extent in every case of it. He also saw a particular type of thought and behavior which he called "autism" as basic to the disease of schizophrenia. He recognized that the outcome was not invariably poor, noting that almost complete remission was possible in some instances, especially where a relatively late and sudden onset occurred. Adolph Meyer (91) also advocated replacing the term dementia praecox with schizophrenia. In addition, Meyer suggested a

psychobiological approach to mental disease which could encompass the interaction of constitutional factors with environmental ones in determining the course and outcome of the disease in question. Sullivan (114) believed that "schizophrenia" should be applied to only those "disorders of living" which have an acute onset due to some identifiable stress situation and a good prognosis, while "dementia praecox" should be reserved for that disorder having an insidious onset and a poor prognosis and which seems to be an organic, degenerative disease. Strecker and Wiley (111) arrived independently at essentially the same conclusions.

Development of the Process-Reactive Concept

Perhaps taking a leaf from Kraeplin's book, investigators of schizophrenia have used outcome of the illness as a popular criterion for classifying patients. It has been repeatedly observed that some patients have relatively severe and "stormy" schizophrenic breaks while in others the disease develops in an insidious manner over a period of years beginning in early childhood. Along with this, it has been noted that a startling positive correlation exists between a late, sudden and stormy onset on one hand and good prognosis on the other. Conversely, the patient who undergoes a progressive and gradual deterioration is much less likely to recover (24, 66, 79, 86, 111, 121, 122). Langfeldt (79) introduced the term "process schizophrenia" to describe the poor prognosis group while he labeled the group with

better prognosis "schizophreniform". D.E. Cameron turned his attention to the early symptoms and distinguished two main groups on the basis of their activity levels (29). His evidence indicates that hypoactive patients usually show these characteristics for a longer time before hospitalization than the hyperactive patients have shown behavioral abnormalities. Low activity-level, then, is most often associated with insidious onset. The patient's personality prior to his becoming psychotic was focused upon by Darrah (33). He considered dementia praecox to be characterized not only by early and insidious onset with progressive deterioration, but also by a schizoid prepsychotic personality. On the other hand, schizophrenia was shown by an abrupt onset and a milder, nondeteriorating course of the disease, and was usually associated with an adequate prepsychotic personality. These views have generally been confirmed by other investigators (66, 86, 111, 124). Other ways which have effectively divided the patients into two groups correlating with their prognosis found: 1) Inappropriate or dull emotionality implies poor prognosis while neurotic and affective features are indicative of good prognosis (33, 79, 86, 111); 2) Identifiable precipitating stress is associated with good prognosis, and its absence is an ominous sign (33, 66, 86, 111, 114); 3) A "clouded sensorium" is a more favorable sign than retention of orientation in time, place and personal identity during a psychotic episode (24, 66, 67, 111, 122); and 4) a family

history of schizophrenia is associated with a poorer chance for recovery (33).

In contrast to the dichotomous or bimodal distribution of schizophrenic patients suggested by the above discussion, Wittman and Steinberg (121) concluded, after studying case histories of neuropsychiatric patients of all types, that a bell-shaped curve seemed more descriptive of the actual population. Their distribution ranged from "process" at one end of the scale to "manic-depressive" at the other with categories of "schizophrenic", "normal", and "hypomanic and depressive" falling in that order between the extremes. The writers also concluded that their study provided supportive evidence for Meyer's theory of the "shut-in" personality type, a concept very similar to Langfeldt's "process schizophrenia". The continuum idea, suggested by Wittman and Steinberg as descriptive of the population at large, was applied to schizophrenic patients by Bellak (21, 22). After reviewing 3200 papers, manuscripts, and books on schizophrenia, he formulated what he called a "multiple factor theory" of its etiology. Each case, he suggested must be seen as the result of both somatic and psychogenic features and ..."it may be helpful to conceive of any given case as actually occurring on some point of a continuum from a hypothetical point of almost complete psychogenicity to a hypothetical point of almost complete organicity" (22, p 740). The common denominator in all cases, according to Bellak, "is a severe

decrease of ego strength to a point where the ego is incapable of mediating properly between Id, Superego, and reality" (22, p 752). Consequently, there is a return to more primitive patterns of behavior. Ausubel (16, 17) concurred with Bellak in describing schizophrenic patients in terms of ego deficiencies, but concluded that two distinct forms, "evolutionary" and "reactive" could be clinically recognized.

Kantor, Wallner and Winder (67) were the first to label as such the "process-reactive" dichotomy. Strong indications of reactive schizophrenia were felt by these authors to be: (1) a relatively normal pre-psychotic personality; (2) sudden onset with the presence of logical precipitating factors and (3) loss of a clear sensorium. The process syndrome showed just the opposite characteristics. After their subjects were rated as either "process" or "reactive" from case history data, they were given the Rorschach test and designated either "psychotic" or "non-psychotic" on the basis of their Rorschach responses. It was found that reactives tended to be called non-psychotic and that the process group tended to have a greater number of psychotic-like responses. The authors concluded that there is a legitimate basis for classifying schizophrenics as either process or reactive and that the two groups differ in their "psychological function characteristics".

Brackbill and Fine (27) also administered the Rorschach test to patients classified as being either process or

reactive and to a third group with "known central nervous system pathology". They found that the reactive group was distinguishable from the other two but that the process schizophrenics could not be differentiated from the organics on the basis of Rorschach signs. These results suggested to the authors that the difficulty in arriving at a differential diagnosis between "some kinds of schizophrenia and organics results from the involvement of central nervous system pathology in process schizophrenia". A recent study by McDonough (84) tested this conclusion by use of two perceptual tasks on which individuals with cortical damage have shown gross defects. His schizophrenic patients were screened to include only those with no known brain injuries or brain tumors. Then they were classified as being either process or reactive on Becker's revision of the Elgin Prognostic Scale (see appendix) and compared with a group of normals and with a group of individuals having known brain damage. The tests used were for critical flicker fusion and for the Archimedes spiral aftereffect. On the basis of test results, normals and both groups of schizophrenics could be distinguished from organics but not from each other. No evidence of cortical damage in schizophrenia could be adduced from these data.

In two recent publications Becker (19, 20) advocates the continuum position proposed by Bellak. He cites Bellak's evidence for multiple causation of schizophrenia and also points out that in clinical practice the two groups are

found to merge into each other and to overlap. Rather than making distinctions in terms of etiology, as Bellak did, Becker prefers to speak of a continuum of "levels of personality organization" with the process group at a level of "very primitive undifferentiated personality structure, and the reactive syndrome a more highly organized one". Although there is no necessary contradiction between this view and Bellak's, Becker believes that the patients level of functioning affords a more fruitful point of departure. He conducted a study in which schizophrenic patients were classified by means of a prognostic scale as being on a process-reactive continuum. Then each subject was given a Rorschach and a proverbs test with the expectation that process schizophrenics would show more regressive and immature thinking than would be shown by the reactives. This hypothesis was confirmed to a large extent. Statistically significant relationships between position on the continuum and Rorschach "genetic" scores were shown by both male and female patients. On the proverbs test, however, only the male patients showed the predicted differences to a significant degree.

Evidence from a number of studies, then, indicates that dividing schizophrenic patients into two groups, process and reactive, affords an additional dimension which is useful in describing the individual patient. The hypothetical "pure" process schizophrenic has grown gradually into his psychosis during the course of his development; diverging from the

path of "normal" development at an early age and progressively increasing his distance from the normal path as he matures. The hypothetical "pure" reactive, on the other hand, is an individual who has made a relatively satisfactory adjustment prior to "suddenly" becoming psychotic when subjected to extreme stress. While these "pure" forms are rarely, if ever, identifiable in actual practice, it has proven to be possible to distinguish between the primarily process and the primarily reactive schizophrenics with a high degree of reliability. Once such a distinction is made, significant differences between the groups in terms of prognosis and in terms of differing behavior in a variety of experimental situations can be found. It therefore seems possible, or even probable, that some aspects of schizophrenia are obscured by the use of traditional Kraeplinian diagnostic labels. There is also reason for hope that use of the process-reactive system of classification and description may afford opportunities for additional insights into the nature of schizophrenia. The possibilities appeared promising enough to the writer to justify incorporation of the concepts in the present investigation.

Adaptation

Adaptation is a biological necessity. Every surviving species has, during the course of its evolution, developed adaptive and protective mechanisms which facilitate adjustment to the conditions it must meet. These mechanisms of

adjustment, often operating without conscious volition or even awareness on the part of the individual, enable him to deal more efficiently with inner situations or environmental conditions that might otherwise disrupt his functioning.

Within the field of clinical psychology, experimental investigators and theorists have, traditionally, focused their attention almost entirely upon the "defense mechanisms" having to do with ideation. Examples of these are repression, resistance, sublimation, rationalization, reaction-formation, and projection. Noyes, in his recent book (92) describes and discusses no less than twenty defense mechanisms of this nature. Since these particular modes of adjusting are not the primary concern of the present investigation, the interested reader is referred to any standard text of personality dynamics for a more thorough discussion (57, 92, 118).

More recently, attention has been given to differences in physiological responsiveness as indices of comparative effectiveness in adjusting. Extensive work in this area has been carried out by Selye (103) and his co-workers. They offer evidence of a triphasic pattern in the evolution of adaptation to any affront to the organism. The affront may be of any sort including such diverse conditions as physical injury, changes in temperature, fear, psychological stress, or infection. Under all these conditions, the physiological reactivity follows the same "general adaptation syndrome" (GAS). The beginning phase or "alarm reaction" is

characterized by generalized and increasingly diffuse adaptive responses necessitated since no organ system is as yet specifically developed to cope with the task at hand. Following this is the "stage of resistance" in which the appropriate organ system has mobilized to handle the stress. It alone is activated by the regular or continuing stress, and other physical reactions of the body proceed more or less normally. Finally, if uninterrupted, the process leads to the "stage of exhaustion" in which diffuse and uncontrolled reactions appear once again due to the inability of the organism to maintain its confinement of the stress to a limited area, and this stage continues until death. Each stage is characterized by measurable changes in the physical organism. Selye posits a certain amount of "adaptation energy" present at birth, and most probably genetically inherited, which the individual may spend lavishly or frugally, but which cannot be replaced. According to this view, physiological reactivity is determined by the severity of stress, the length of time since inception of stress, and the individual's reserves of "adaptation energy" rather than being a function of the particular disease or agent which acts as stressor.

In a study specifically investigating differences in adrenal cortical responses associated with personality disorders, Pincus and Hoagland (96) found that schizophrenics as a group showed adrenal cortices typically less responsive to stress and unable to alter action to meet changing

environmental demands. Funkenstein and his co-workers (46, 47, 48) conducted a series of studies investigating possible relationships between physiological reactivity to drugs and remission of illness in schizophrenia. They found that patients diagnosed as being schizophrenic were quite varied in the degree of their autonomic nervous system responses when given epinephrine and mecholyl. Seven subgroups were formed on the bases of blood pressure and re-establishment of homeostasis. It was found that patients who showed the greatest reaction to the above drugs had the best recovery rates following electroshock therapy. Funkenstein et al concluded that their measurements of autonomic reactions provided a better prognostic indicator than did the clinical diagnoses of the patients. These conclusions were confirmed in later studies by Hirschstein (52) and by Geocaris and Kociker (49).

Williams (119) investigated the autonomic reactivity of schizophrenics in response to psychological, rather than chemical stressors. He defined his experimental group more carefully and confined his study to "early chronic schizophrenic reactions". His patients were called "early chronic" if they had been hospitalized one to three years and had shown "little or no lasting response to treatment". The diagnosis in each case was agreed upon by three psychiatirsts and three psychologists. He found that when the galvanic skin response (GSR), pulse, and respiration rates of these

patients were compared to those of normal subjects, some consistent differences appeared. The schizophrenics showed a greater than normal background physical activity when they were at rest, and the higher activity level tended to continue under stress conditions with a less-than-normal amount of variation under changing conditions. These findings were confirmed and extended by DeVault (36) who took even more variables into account as he sought to relate the findings of Funkenstein et al to the process-reactive concept of schizophrenia. DeVault selected schizophrenic patients who could be classified as either process or reactive from information concerning their pre-psychotic personality, apparent precipitating stress, type of onset, and clinical picture. Then he compared the autonomic reactions to psychological stress of these two groups with each other and with the reactions of a control group of normal subjects. Each subject was shown four pictures, one "neutral" and the others chosen to express feelings of "hostility", "dependency", and "sex". In addition to these stimuli, a loud bell was sounded following a verbal warning that it was to be rung. Measurements of the subject's base level and amplitude of heart rate, base level and amplitude of GSR and length of time for GSR arousal and recovery were taken. His reactive schizophrenics were similar to normal subjects in amplitude of GSR and changes in heart rate, but tended to be slower in homeostatic recovery than either the normal or process group. His

process group resembled Williams' "early chronic" schizophrenics in showing less extreme and slower changes in GSR and heart rate than the other two groups.

Motor Learning

A related but separate approach to studying an individual's adaptive functioning is offered by analysis of his learning processes. Since learning is perhaps the most characteristic form of human adaptation, its importance is obvious. It is hardly surprising, then, that a very large proportion of psychological literature is concerned with this general area. More specifically, the area of motor learning provides opportunities for obtaining objective measurements of several variables in the learning process, and it has increasingly occupied the attention of psychologists since the beginning of the present century. Laboratory studies have usually been directed at finding a relatively simple type of motor activity with which the learner has had little or no opportunity for previous experience. Then systematic observations and analysis of changes in performance are made. Pioneer studies of qualitative changes at various stages of learning of skills are reviewed by Woodworth (125) and by McGeoch (85). There is a striking regularity in the various reported curves of motor learning. From a mass of experimental investigations, the following consistencies in the learning process have been noted: (1) The majority of studies of motor learning have shown spaced practice (i.e. practice

periods interspersed with rest periods) to be more efficient than massed practice (continuous performance); (2) During rest periods between practice sessions, there is a gain in ability to perform. This phenomenon is usually referred to as "reminiscence". (3) During the early part of each practice session after the first, there occurs an increase in performance scores which is relatively rapid as compared with initial learning. This spurt in performance is now generally referred to as "warm-up". These phenomena provide approaches to the analysis of individual differences in motor learning which are in addition to such measures of the gross performance as speed of learning and the level achieved. Accordingly, they have been widely investigated and have frequently been the focus of theoretical formulations. It may be noted that all three of these phenomena involve interruptions of practice to at least some extent. It is not surprising, then, that in their attempts to interpret curves of motor performance, various theorists have concerned themselves with factors operating in the rest periods either wholly or in part. A more detailed examination of the pertinent variables follows.

Warm-Up

In the interference theory of forgetting this would be attributed to the action of incidental sources of interference. That is, some of the cues in the situation become associated with responses which conflict with the task. One

immediately obvious example of such a competing response is resting in a situation similar to the one in which the activity is carried out. Irion (61) points out that competing responses learned in this incidental fashion should be relatively weak in strength as compared with the purposive responses of the task. Both he and Ammons (6) suggest that a more important factor than loss of retention is a loss of the "set" to perform the task. No matter what the task may be, certain postural, receptor, and attitudinal adjustments are most favorable to performance. The subject must look at the right place at the right time, impress a certain optimal pace on his activities, and attend to those particular cues that are crucial in guiding and adjusting his responses. All these activities contribute towards a background of self-stimulation that is more-or-less unique for each task and that is referred to as the "set" to perform this task. This set, they point out, is a major part of the total stimulus situation in which the task responses are learned. During a rest period, the set is lost, the total stimulus situation is modified, and the probability of correct responses being made early in practice after the rest is reduced. Upon resumption of practice, the subject must make again the orientational responses originally associated with the correct responses. Until he has done so, his performance will be below that which he is capable of achieving after warming up. Irion first investigated warm-up from the standpoint of

re-establishment of set in a verbal learning situation (63). His subjects were required to memorize paired nonsense syllables as they appeared on a revolving memory drum. After 24 hours rest they were divided into two groups and retested. The experimental group, before being tested, were placed in front of the memory drum and required to name colors as they appeared. This was intended to re-establish the cues of the original learning situation. The testing for memory of the nonsense syllables, which followed immediately, revealed that the experimental group not only surpassed the control (no warm-up) group, but that they showed no forgetting and had even improved somewhat in performance. Irion, in another study (62), and Ammons (11) sought to determine whether Irion's findings regarding the resumption of set on a memory drum also applied to motor learning. Both investigators used the pursuit rotor task in their studies. Irion concluded that the amount of warm-up effect is a function of both the amount of pre-rest practice and of the length of the rest interval. In other words, it depends upon a combination of how definite a set had been established and how much of the set had deteriorated. Ammons (11) used 8 different conditions of pre-practice warm-up after a rest of 17 minutes. "It was concluded that the present types and durations of pre-practice activity do not produce significant changes in subsequent performance level, warm-up decrement, or temporary work decrement. These results do not support

an energy-expenditure explanation of temporary work decrement, or a rehearsal theory of reminiscence. They do seem to indicate that verbal and motor performance are affected differently by pre-practice warming-up activities" (1, p 191).

A different approach to the measurement and investigation of warm-up is provided by the method of having the subjects resume working at the original task without special preparation. The "warm-up decrement", or the amount by which initial post-rest performance is below expectation because of the necessity for warming up is then calculated. Ammons' (6, 7) approach to the problem was to first construct a performance curve showing the subject's scores at frequent intervals during practice. A straight line was then fitted by the method of average decrement to the "relatively decremental portion" of the performance curve which follows immediately after the initial post-rest spurt. The line is extended backwards through the high point reached in this spurt and extrapolated on back to a point directly above the score for the first post-rest trial. The difference between the actual score and the point arrived at by extrapolation represents an estimate of warm-up decrement. Two methods for making these calculations in cases where practice is sufficiently spaced to result in absolute losses in performance level were introduced by Adams (3): (a) decremental method--the difference between the performance level on the last pre-rest trial and the first post-rest trial; and (b)

initial increase method--the difference between the performance level at the peak of the sharp initial rise of the post-rest performance curve and the level of the first post-rest trial. Both methods have been found to give essentially the same results (3, 18, 64). Several studies using these approachs have provided useful information about the nature of warm-up decrement: (1) It appears at the beginning of each practice session under both massed and distributed conditions (2, 3, 18, 35) and the length of the intertrial rest is not systematically related to the amount of it shown (64). Thus we can reject the hypothesis that warm-up decrement is related to the growth of inhibition (or work decrement). (2) The warm-up decrements for distributed practice quickly achieve a maximum and then display a trend of decreasing magnitude as practice increases (3, 18). This supports Ammons (6) hypothesis that practice is regaining set should lead to less warm-up decrement. This is demonstrated especially forcefully since it has been shown that a positive relationship exists between amount of warm-up decrement and the performer's degree of proficiency (2, 64). (3) Massed practice produces no consistent warm-up trends (3, 18). It can be concluded that complicating factors are present under massed conditions and that distributed practice represents the simpler case for the study of the warm-up phenomenon.

Reminiscence

In some situations reminiscence, or gain over rest, may

be attributable to extra practice in the form of overt or implicit rehearsal during the rest period. That this is not a sufficient explanation, however, is established by the fact that spaced practice proves to be beneficial in many situations where rehearsal is prevented by such measures as filling the "rest" period with controlled activity. It also seems unlikely that rehearsal is an important factor in motor learning situations in which verbal cues play little part.

Another obvious possibility is that fatigue or boredom and its concomitant changes in motivation are responsible for reminiscence. For example, prolonged practice may result in fatigue, and a rest interval may bring about a recovery from it with a resulting improvement in performance. Granting that this may be a factor, the evidence is against it being the sole explanation since reminiscence is sometimes demonstrated with learning sessions so short that they could hardly cause fatigue. The same reasoning can be applied to motivational factors. Subjects who have become bored with a task may well cease to perform optimally and then show renewed interest after a rest. On the other hand, the consistent appearance of reminiscence after very brief practice periods makes it unlikely that sudden onsets of boredom could be the sole explanation.

Still another partial explanation of reminiscence is offered by McGeoch (85). It is suggested that differential rates of forgetting may be a contributing factor. The

incidental, distracting associations could be expected to be forgotten more quickly than the elements of the situation receiving conscious attention. Forgetting of the "wrong" responses would then make the desired responses more probable. While this theory has considerable face validity in verbal learning tasks such as memorizing word lists, it has little applicability to motor learning in which verbal cues play little part.

In some motor activities, barriers to response similar to the "refactory phase" in neural functioning appear to be operative. A tendency to avoid repeating responses at short intervals and also an increase in serial reaction time with closely spaced stimuli have been demonstrated in a few situations (55). An extension of this theory postulates a type of neural "after-effect" which is called "perseveration" by its authors, Müller and Pilzecker. Their theory is supported by Woodworth:

> The size and internal structure of the muscle fibers improve after exercise, and this nutritive after-effect takes some hours to reach completion. The same after-effect, occurring in the nervous system, may "consolidate" the memory trace of an activity (125, p 216).

This concept is capable of explaining reminiscence, but it is difficult to test since it has not been operationally defined. It appears, also to rest on meager physiological evidence (55, 117).

The maturation hypothesis of learning is very closely related to perseveration theory in that it too postulates

some kind of growth process following the stimulation from learning activity. Although this hypothesis "is rooted in the writings of Wheeler, and of Wheeler and Perkins" (37), it was first stated in a form specific enough to allow it to be experimentally tested by Dore' and Hilgard (38). According to these authors, the hypothesis has two aspects which they describe as follows:

1. Age maturation "The capacity of an organism to improve with practice is a function of its age-level of maturation" (38, p 246).

2. Stimulation-induced maturation "At any given age-maturation level the optimum rate of stimulation to secure improvement in a given function depends upon the normal rate of stimulation-induced maturation in that function" (38, p 246).

The first part stating that there is a relationship between the performer's maturation level and his learning efficiency seems to be beyond doubt. It has been established again and again by the authors of the various psychometric devices in everyday use in schools and clinics. Experimental evidence that it is also true in motor learning situations has been presented. Adams and Reynolds (2) found interaction effects between the initial level of ability and gains in performance among 960 recruit airmen. Ammons, Alprin and Ammons (12) also found pursuit rotor performance to be related to both sex and age of school children. The second part, much akin to the Perseveration Theory above and to

Snoddy's (108) "primary growth", has occasioned pause and more than one lifted eyebrow. According to this principle, stimulation-induced maturation is a function of time. Within certain limits which vary according to the nature of the task, passage of time since inception of practice is more important than the actual amount of practice undergone. Dore' and Hilgard (38) carried out an experiment to test this inference by use of the Koerth pursuit rotor. Four groups of subjects were given 7, 13, 22 and 31 one-minute trials in a total elapsed time of 43 minutes. When their performance was measured at the forty-first minute, the last three groups scored about the same while the first-mentioned group scored considerably lower. While these findings were consistent with the maturation hypothesis, the authors also pointed out that this hypothesis need not be envoked to explain the results obtained since they could be explained as adequately in terms of more commonly accepted concepts. A later study by Dey and Ammons (37) utilized a compensatory pursuit task at which five groups of subjects received either 45, 30, 23, 13, or 8 one-minute trials with intertrial rests of 0, ½, 1, 2½, and 5 minutes respectively. Their results showed learning to be more nearly proportional to the amount of practice than to elapsed time and therefore not consistent with the maturation hypothesis. A thirty-second rest between trials led to a better performance than did massed practice, but increases in the length of interpolated rest up to five

minutes did not result in further improvement. Evidence thus far suggests, then, that reminiscence does occur during the rest periods and the Maturation hypothesis offers a possible explanation for some of it. However, the same phenomena can be explained by use of more conventional concepts. In at least some areas, the Maturation hypothesis as presently stated would lead to incorrect predictions.

All the formulations so far discussed might be called single-factor explanations of reminiscence. As Ammons (6) points out, any curve with two or more inflections cannot very adequately be accounted for by the simple operation of one factor, and the curve of motor learning has at least two inflections. Hull (56) introduced the dual concepts of reactive inhibition and conditioned inhibition which are now rather widely used as intervening variables by investigators of motor learning. Reactive inhibition is regarded as a negative drive state. It accumulates during work and depresses performance since the making of a response sets up a tendency not to repeat that response. It is assumed to be a type of temporary inhibitor of response that dissipates spontaneously during rest. In this way, it is used to explain part of the superiority of distributed practice over massed practice, and the gain in performance during a rest which follows massed practice. Conditioned inhibition is defined as a habit of resting for which the drive is reactive inhibition and the reinforcement is rest. Like reactive

inhibition, it depresses performance but, as a habit, it does not dissipate spontaneously over short rest periods. Therefore, reminiscence would be described in Hullian theory as due to the dissipation of reactive inhibition, and permanent differences in performance found to exist between massed and distributed performance as due to the greater amounts of conditioned inhibition generated under massed practice conditions.

The Hullian concepts, being incorporated in a more general theory and being more widely known as well as being stated in such a way as to make them amenable to experimental check, have been more thoroughly investigated than any other of the foregoing formulations. Melton (90) and Kimble and his co-workers (68, 69, 70, 71, 72) in a series of studies confirmed the presence of, and gave quantitative meaning to the temporary decrement in performance associated with reactive inhibition and the more "permanent" decrement associated with conditioned inhibition. These findings, in-so-far as they apply to reactive inhibition, have been borne out in a number of independent studies. With regard to conditioned inhibition, however, some reservations have been voiced. Starkweather and Duncan (110) proclaimed themselves unable to elicit a statistically significant amount of conditioned inhibition in a study employing the pursuit rotor. As the authors themselves note, however, they ignored the warm-up phenomenon and thus reduced the differences between their

groups. A number of studies (7, 3, 18, 64) indicate that although warm-up is not included in Hull's system, ignoring it is apt to lead to serious misinterpretations of the data.

No single theoretical formulation thus far examined appears capable of adequately accounting for all the phenomena noted without more-or-less major modifications. On the other hand, several useful variables have been identified and experimentally validated. Ammons (5, 6, 9) has provided us with the logical next step (or, more accurately, a series of steps) by choosing promising sets of variables and defining them in terms of a motor performance curve; then proceeding to test and give quantitative meaning to the variables chosen. Ammons' method of calculating warm-up decrement has already been described. A backward extrapolation of a portion of the post-rest performance curve enabled him to arrive at a "corrected initial level" of postrest performance; i.e. an estimate of what the performance on the first post-rest trial would have been had there been no warm-up decrement. A method of calculating <u>temporary work decrement</u> (a concept similar to Hull's reactive inhibition) makes use of the same corrected initial level. In addition to this point, a line arrived at in an identical manner is extrapolated <u>forward</u> from the pre-rest practice session to the first trial of the post-rest practice. This affords an estimate of what performance would have been on this trial had there been no interruption of practice. The difference between these two points

provides an estimate of temporary work decrement that is corrected for warm-up decrement. Finally, the amount by which the corrected initial level is less than the performance level of a group practicing under optimum conditions of distribution of practice is used as a measurement of permenent work decrement (a concept similar to Hull's conditioned inhibition).

Adaptation In Schizophrenia

Extensive investigations of the adaptive responses of schizophrenic patients have been carried out. Kraeplin himself introduced a technique of setting patients to work at a continuous task in order to bring out more clearly the deficit evident in everyday life (57). He observed that with various types of tasks, schizophrenics work efficiently for a short time, but their performance falls off at an abnormally high rate as they continue at the same task. This seeming inability of schizophrenics to maintain goal-directed activity has also been emphasized by a number of other investigators (51, 58, 59, 60, 76, 87, 104, 106). It should be noted, however, that these investigators also found that schizophrenics consistently showed both greater intrasubject variability and a greater range of abilities between subjects than did the normals. Several possible explanations of this state of affairs were proposed by Huston et al (59): Schizophrenia is said to entail loss of interest in the environment with consequent lowered motivation for task performance; greater

occupation with fantasy and therefore more tendency toward a "drifting away" of attention; reduction in energy output which would lower the patient's ability for sustained production; and inadequate or inappropriate affective response with its concomitant decrease in predictability of reactions. To these explanations might be added psychobiological adaptation which is faulty to varying degrees (91), and last but not least, the strong possibility that heterogeneous groups were subsumed under the classification of "schizophrenic patients". In support of the latter possibility that heterogeneous groups were subsumed under the classification of "schizophrenic patients". In support of the latter possibility, Shakow and Huston (60) concluded that when only "those patients who cooperated as well as the normal group were compared with the latter the differences between the groups disappeared". This would seem to indicate that schizophrenia per se is not the pertinent variable. Knehr (77) obtained results consistent with Kraeplin in that no differences in speed of reaction was observed when a group of schizophrenics were compared with a control group, but H. King (76) found chronic schizophrenics "clearly less rapid in psychomotor response when compared with the normal on all individual subtests of the experimental battery". Equally differing results have been obtained in studies of conditioning in schizophrenic patients. For example, Bender and Schilder (23) found that "schizophrenics show evidence of

conditioning quite as quickly as normal subjects, but the conditioned response differed considerably". Shipley (107) reported that schizophrenics both acquired and extinguished GSR responses more readily than other groups. Results of both of these studies were confirmed by Malmo and Shagass (87) whose patients showed a greater responsiveness and lower threshold of reaction but a lack of discrimination. Pfaffmann and Schlosberg (95) found no differences between schizophrenics and normals in conditioned knee jerk. Two studies by Peters and Murphree (93), on the other hand, directly contradicted these findings. Their chronic schizophrenic subjects displayed less autonomic responsiveness to unconditioned stimuli than did normals and treated patients, and they also conditioned less readily than either normals or treated patients. May (88) also found diminished pupillary responsiveness to pain and light in schizophrenic patients. Fischer (42) suggested that an "initially abnormally low threshold toward stress is raised during the schizophrenic process to an abnormally high one". A series of studies by Shakow and his associates extending over a period of years (58, 59, 60, 104, 105, 106) have been devoted to the investigation of the learning of purposive responses by schizophrenics. They have found these patients to be most defective in situations requiring constant voluntary readjustment but almost normal in performing prolonged, unchanging tasks. Similarly, Wulfeck (126) found that "speed of

adjustment and response is most notably affected" while a curvilinear relationship seems to exist between the level of complexity of the task and the schizophrenic's performance on it. This suggested to Wulfeck "that schizophrenia is a disease which reduces ability of patients to perform intermediate level motor tasks". Malmo et al (87) in a study of responsiveness in chronic schizophrenia found "purposive" overt acts to be less frequent than in normal subjects, but tension levels of schizophrenics to be higher. Skinner and his associates at Harvard (50) used a type of vending machine to study quantity and regularity of "operant" behavior of chronic schizophrenics under a variety of conditions. An "operant response" is viewed by Skinner et al as a "behavioral unit that manipulates part of the environment, representing as such 'adjustive behavior'". Like Shakow et al and Malmo et al, they found an inverse relationship between the rate of voluntary manipulative movements and severity of psychosis. Similar conclusions were reached by H. King (76) in his study of groups of normals, neurotics, "pseudoneurotics" and "chronic and severe" schizophrenics divided into three groups ranging from "least disturbed" to "most disturbed". He tested their speed of initiating movement in response to a buzzer, speed of alternately tapping two metal plates, and manual and finger dexterity. His findings were that the chronic schizophrenic groups were "clearly less rapid in psychomotor response" with greater degrees of retardation

becoming apparent as symptomatic expression of psychosis increased. G. King et al (73) found a different state of affairs in their study of 30 "acute schizophrenic subjects". Subjects rated as being intermediate in the severity of their psychosis responded at a relatively higher operant rate than subjects rated either high or low in severity of illness.

Development of the Problem

From the studies that have been discussed, it may be concluded that, despite over half a century of investigation, theorizing, and speculation, there is still a great diversity of opinion as to the nature of schizophrenia. The results of the investigations are inconclusive in some cases and even directly contradictory in others. It is proposed that a return to investigating some of the formal characteristics of schizophrenia may prove rewarding at this point. However desirable it may be to identify the etiology (or etiologies) of schizophrenia (or the schizophrenias), there is also a pressing need to know just what we are working with. There seems to be good reason for hope that a more precise descriptive system will contribute toward understanding and perhaps reconciling some of the apparent contradictions in findings derived from various studies of the disorder. Significant progress in this direction has been afforded by applications of the process-reactive classificatory concept. If this essentially longitudinal approach is supplemented by an intensified cross-sectional one, perhaps much may be

accomplished.

One promising avenue of approach to such a cross-sectional study is through an investigation of the patients' motor performance. The argument that movement factors play a primary role in the adaptation of all forms of animal life to the environment is too convincing to be easily abandoned.

From the studies that have been discussed, it seems legitimate to conclude that variations in amount of operant motor behavior are peripheral rather than essential or "core" variables in at least some cases of schizophrenia. While they give quantitative meaning to the often-expressed observation that schizophrenia is associated with defects of volition, they add little to our knowledge of the essential characteristics of the disease except in the sense of demonstrating that defective conation is a frequent but not invariable concomitant. In a recent study, Reisman (98) found evidence that differences in motivation and work rate within the schizophrenic group could be predicted from their classification as process or reactive. Rather than attempting to establish how much variation a group of patients show in their operant responses, perhaps it would be more fruitful to investigate the factors involved in the variation when it occurs. Recent advances in the analysis of motor learning provide objective methods for investigating qualitative differences in performance. Applications of such concepts as <u>temporary work decrement</u>, <u>permanent work decrement</u>, and

warm-up enable us to speak of the ways in which individuals vary in their performance where previously we had been confined to measuring the amount of gross variation.

The pursuit rotor task has several advantages to recommend it in studies of this nature: It requires an activity that is sufficiently different from ordinary life situations to insure that learning it will be largely unaffected by prior experience, yet it is simple enough to be easily understood by even relatively confused subjects; and, methods of isolating the pertinent variables have been worked out and experimentally validated by a number of investigators. In addition to this, there is evidence that, given a minimal amount of compliance on the part of the subject, motivational factors play little, if any, part in the appearance of the variables in question (8). Since this evidence was obtained from a sample of college students, however, it may or may not hold true for psychotic patients. It was concluded by Ammons (10), that learning of the movements necessary for performance on the pursuit rotor "may well involve the building up of manual and ocular movement patterns of a ballistic type". He defined ballistic type movements as "sweeping movements where change of direction takes place in less than normal reaction time and is consequently not under direct cortical control". Perhaps related to this factor are the findings of Brewer et al (28) that occurrence of brief noises during pursuit rotor performance had "no statistically

significant disinhibition or external inhibition effects..." and that it had no discernable permanent effect on the performance level.

Preliminary Study

A preliminary study to investigate the applicability of the variables involved in the pursuit rotor task to schizophrenic patients was carried out. Prior to beginning the study, it was necessary to decide at what speed the rotor should turn. Two considerations were primary in arriving at this decision: (1) A number of studies have shown that schizophrenics as a group tend to be slower than most normals on psychomotor tasks, and the degree of their retardation is directly related to the severity of the illness (58, 59, 60, 76, 104, 105, 106); and (2) This investigation was primarily concerned with relationships between variables rather than with measuring amounts of deviations from "normal" performance. Therefore choosing a rotation speed within the capabilities of the particular patient group was of more importance than choosing one giving direct quantitative comparisons to other groups. In pre-experimental trials, it was empirically determined that patients of the general psychotic level of the sample were most often unable to perform the task at the conventional speed of 60 rpm. Many of them refused to even attempt it. At 45 rpm, however, most of the patients would attempt the task, and could experience some success at it.

Apparatus

A Koerth-type pursuit rotor which turned clockwise at

45 rpm was employed. The rotor disk was black, 28.5 cm. in diameter, and had a brass target 1.9 cm. in diameter set 8.5 cm. from its center. The stylus was hinged near its wooden handle so additional pressure could not be exerted on the rotor disk by "bearing down" on the stylus. Both the brass target and the rounded tip of the stylus were polished with fine sandpaper before each subject began practice and at each five-minute rest period. Two Standard Electric timers recorded time on target in units of .01 second alternately every 30 seconds. This was readily accomplished by manual operation of a toggle switch, the examiner recording time on target and resetting one time to zero while the other timer was in circuit during massed trials. Distributed trials and the final massed trials were terminated by changing circuits at the same time the examiner said, "stop" in order to prevent accidental continuations of time on target. Similarly, the signal to begin was accompanied by a changing of circuits in order to forestall premature starts upon subjects being told to "get ready".

Procedure

Each subject was given instructions as to the operation of the rotary pursuit device and a demonstration in performing the task by the examiner. Following this, the subject was instructed to try it himself. If he demonstrated that he understood what was to be done, trials were begun immediately. If he showed himself unable to follow the directions,

instructions and demonstration were repeated. Six subjects from the original group of 44 had to be discarded from the sample due to inability or unwillingness to continue. Massed practice (M) consisted of continuous practice while distributed or spaced practice (D) consisted of alternating intervals of 30 seconds work and 30 seconds rest.

The first of the three practice sessions consisted of four 30-second distributed trials for all subjects. After a five minute rest, all subjects were given twelve 30-second trials which were massed for half the subjects and distributed for the other half. Then, after another five-minute rest, these two groups were again divided with half of each group being assigned to massed practice and the other half to distributed practice. Thus there was one group for the first session, two for the second session, and four for the third. The conditions of spacing under which the four subgroups practiced were: D-D-D; D-D-M; D-M-D; and D-M-M. Each change of conditions was accompanied by a five-minute rest, and prior to each shift in conditions, the subject was informed of the change. During distributed practice, the subject stood in front of the rotor during the rest interval. He was told "pick up the stylus" five seconds before the beginning; "get ready" two seconds before the beginning; and "go" as a signal to start. The subject always began a trial with the rotor in motion. During the longer rest periods, the subject sat down and conversed or read, and similar

preparatory instructions were given before the start of a new trial.

Results and Discussion

Scores for the four groups on Trial 1 were subjected to a simple analysis of variance as a test that they were random samples from the same population prior to differential treatment. The differences proved to be statistically nonsignificant, permitting retention of the null hypothesis. F was equal to .95 with 3 and 36 degrees of freedom.

The performance curves for all groups are plotted in Figure 1. The expected superiority of distributed practice over massed is immediately observable. Next, straight lines were fitted to the curves in Figure 1 by the method of average decrement as suggested by Ammons (6, 7), and the straight lines were extrapolated forward and backward to estimate what the scores on adjacent trials would have been had there been no rest. From these data, calculations of warm-up, temporary work decrement, and permanent work decrement were made. "A" in the figure is the total temporary decrement following distributed conditions and represents 2.87 seconds of time on target. "B" is warm-up decrement under the same conditions, and this represents 2.23 seconds or 78% of the total temporary decrement. If temporary work decrement is corrected for warm-up decrement, only a negligible amount (0.64) remains. This was interpreted as indicating that temporary work decrement (or reactive inhibition) did not

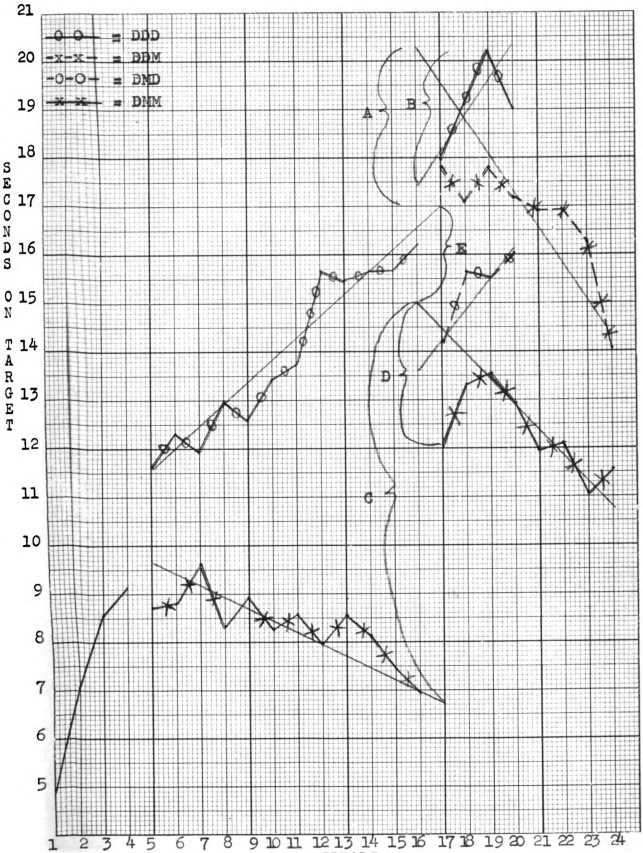

Fig. 1. Performance Curves and variables, Preliminary study.

build up under these conditions, and the performance curve of the distributed group can therefore be regarded as approximating the optimal performance of this sample. "C", representing 8.22 seconds, is the amount of temporary decrement following massed practice, and "D", representing 4.99 seconds, is the amount of warm-up decrement under the same conditions. Temporary work decrement corrected for warm-up decrement is 3.23 seconds following massed practice. Finally, "E" is the difference between distributed practice and massed practice which does not dissipate spontaneously over rest and is therefore a measure of permanent work decrement or conditioned inhibition. This amounts to 2.12 seconds in the present case.

The above findings indicate that the variables developed from pursuit rotor studies are applicable to the study of schizophrenic patients. They also indicate that distribution of practice by 30-seconds work and 30-seconds rest is effective in preventing accumulation of temporary work decrement in patients of this level of psychosis. It is to be noted, however, that this group averaged somewhat higher scores at a rotor speed of 45 rpm than normal groups show at 60 rpm. Conclusions as to the relative effects of the various factors are reserved until further comparisons can be made.

Main Study

In the foregoing discussion, it was pointed out that classification of schizophrenic patients as Process or Reactive provided a meaningful additional description of them. Although most of the earlier investigators conceived of process and reactive schizophrenia as a dichotomy, several recent investigators have advocated the use of a continuum approach. A number of factors, both empirical and theoretical in nature, make the continuum concept appear more advantageous. In the first place, it fits clinical observations more closely. As was mentioned earlier, differences of opinion as to whether or not a particular person is schizophrenic are not unknown. Such a person might be regarded as near one of the end points of the schizophrenic distribution. Within the unequivocally schizophrenic group, it is rare to find a case where the patient's history and symptomatology place him completely within one or the other of the two categories. It follows that the continuum is better suited for experimental purposes than is a dichotomy. Whether the overlap between the two groups is attributable to the relative crudity of our measuring instruments or to the nature of schizophrenia, it nevertheless is uniformly found. A continuum permits the experimental use of many patients who would otherwise fall into an indeterminate "mixed" category. At the same time, it avoids a "forced choice" situation

where truly borderline individuals must be placed in one group or the other, thus increasing the chances of obscuring the results. From the standpoint of theory, the continuum idea again seems to be more desirable since it adapts itself well to a greater number of theoretical considerations than would a dichotomous approach. A theoretical explanation of the continuum could be, for example, along the lines of Meyer's (91) concept of psychobiological interaction, or of Bellak's (22) psychogenicity-organicity theory, or a purely psychological one such as Becker's (19). For these reasons, it was decided to use a process-reactive continuum in rating the schizophrenic patients included in this study. The next step, then, was to choose a method of doing so. Becker's (19) revision of the Elgin Prognostic Scale was chosen after consideration of the possible advantages and disadvantages connected with it.

Purposes of the Investigation

The present study was undertaken in an attempt to secure additional evidence concerning the validity and practicality of the concepts of process and reactive schizophrenia: A study of modes of adjusting in a motor learning situation was chosen as a means of obtaining an objective cross-sectional sample of adjusting processes in these psychotic groups. Variables derived from studies of pursuit rotor performance by normal subjects offered convenient tools for accomplishing this purpose and were therefore adopted in the

present investigation. These variables are: temporary inhibition (reactive inhibition, temporary work decrement), conditioned inhibition (permanent work decrement), and warm-up or set.

The present investigation was designed to make use of the findings by Weaver (117), Reynolds and Adams (99), and Denny et al (35) in their studies of the performance of normal subjects.

Methodology

The procedures of Denny et al (35) were duplicated with the exception that the rotor was turned at 50 rpm in the present study whereas the above authors used a rotation speed of 60 rpm. This reduction in rotor speed was considered advisable because of the inability or unwillingness of many psychotic subjects to perform at the more rapid pace.

Apparatus

The experiment was conducted in a quiet room, nine by twelve feet in size, on the second floor of the hospital ward. Windows along one wall gave a view of only another building approximately two hundred yards away. Further illumination, when needed was furnished by a 150 watt bulb above and slightly to the rear of the subject. The same physical equipment that was used in the preliminary study was utilized in this investigation.

Subjects

Eighty male patients in a VA neuropsychiatric hospital

made up the sample for this study. All the psychotic sample was chosen from patients assigned to the Acute and Intensive Treatment Service of the NP hospital. Three hundred fifty two case histories of schizophrenic patients were examined. From these, a total of 176 were chosen on the basis of their having sufficient material to allow rating on the Elgin Prognostic Scale; no history of brain injury or long periods of unconsciousness; diagnosis of psychosis made within the past year; a history free of repeated hospitalizations over the past 10 or 12 years for neuropsychiatric reasons; and definite evidence of the presence of gross schizophrenic symptoms such as hallucinations, delusions, ideas of reference, and bizarre behavior.

As was stated earlier, the device chosen for distinguishing between process and reactive patients was Becker's modification of the Elgin Prognostic Scale. The Elgin Scale was devised by Wittman (122) and first used by her at the Elgin State Hospital. Becker's revision of it (see appendix) consists of twenty statements. Each statement is subdivided into a number of items describing more specifically the degree to which the statement is applicable to the person being rated. Each of the sub items is assigned a numerical value, and the scores of all items are summed to arrive at the person's total score. Wittman, on the other hand, had used only end points to rate each statement. Becker's addition of intermediate values was designed to "add to the precision of

rating" (19). Disadvantages of the scale include a probability of unequal discriminatory ability among the various items and certain departures from the rules of good scale construction. For example, there are different ranges in sub scale numerical values from item to item. Becker's own observation that the scale is curtailed and not discriminating enough at the "normal" end appears to be valid. The advantages, however, seemed to far outweigh the disadvantages. Wittman's original use of the scale (122) showed a two-rater reliability of .87, and subsequent studies (75, 123) showed it to be highly valid as a prognostic instrument. Becker's modification seemed to offer an even greater degree of exactness in rating, and at the same time, to permit a grading along the entire length of the continuum. Therefore it appeared more suited to a continuum frame of reference than did Wittman's original scale or the method of selection used by Kantor et al (67). In a study reported by McDonough (84), the present writer and McDonough had a two-rater reliability coefficient of .89 in rating subjects by use of this scale.

Figure 2 presents the ratings given the 176 patients in the present study on Becker's modification of the Elgin Prognostic Scale from case history material and records of behavior since hospitalization. It is readily observable that the distribution of ratings approximate a normal curve. The reactive sample was taken from the low-score, good

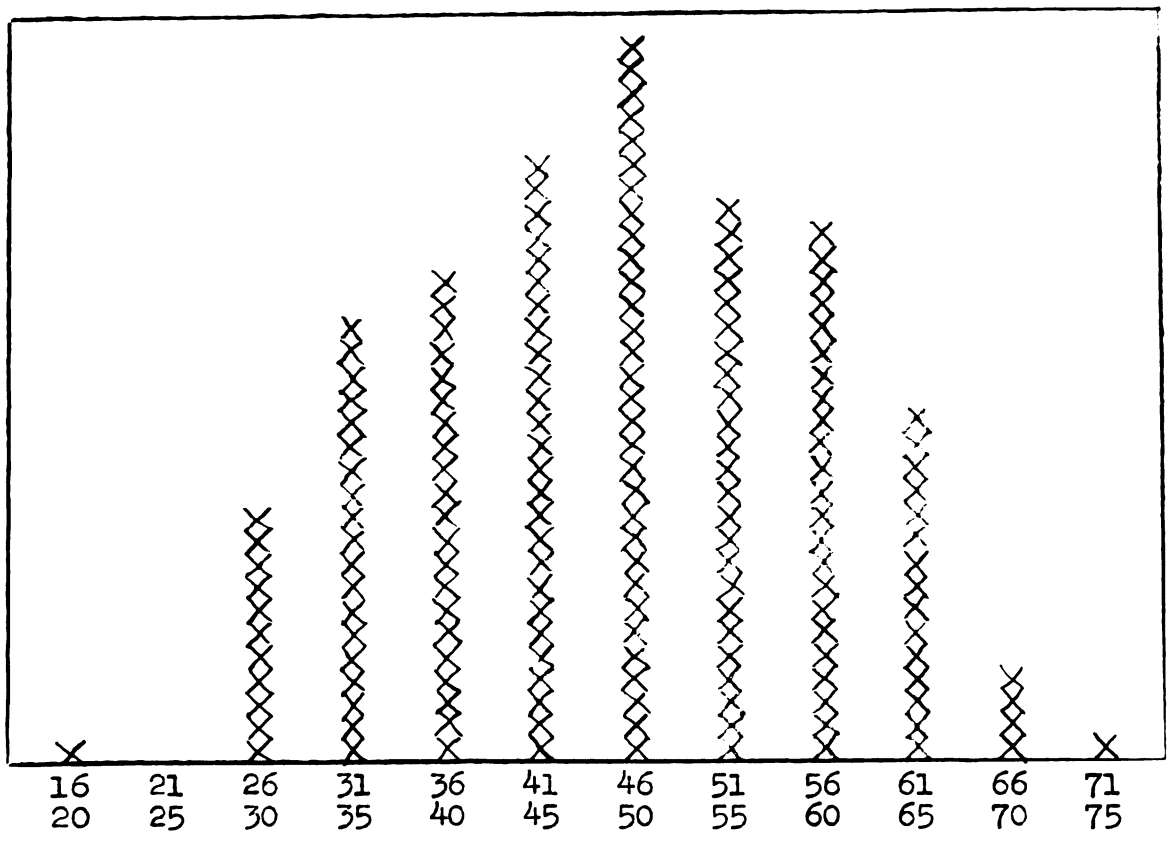

Fig. 2. Ratings on Elgin Prognostic Scale assigned to population from which psychotic samples were drawn.

prognosis end of the distribution and the process sample from the high-score, poor prognosis end. A brief description of the two groups follows.

The process group consisted of 40 patients ranging in age from 19 to 39 years. The mean age was 28.6 years. thirty one of the group were white and nine were Negroes. Diagnoses included 26 schizophrenic reactions of the unclassified type, nine paranoid type, two catatonic type, two simple type, and one mixed paranoid and catatonic.

From the group with the 40 highest scores on the Elgin Scale, qualifying them for inclusion in the process sample, a total of four were not used. Two of these were transferred to another hospital, one was too confused to cooperate, and the other refused to leave his ward. The next four high-scoring patients were substituted in their stead.

The reactive patients ranged in age from 24.5 to 44 years and had a mean age of 31.8 years. This group also was composed of nine Negroes and 31 whites. Diagnoses included 29 schizophrenic reactions, unclassified type; 6 paranoid type, 2 schizo-affective type, and 3 catatonic type.

Four of the group of 40 scoring lowest on the Elgin Scale were discharged from the hospital between the times of rating and testing, and one refused to continue after completing the first practice session. These five patients were replaced in the sample by the five having the next-lowest ratings. Seven other reactive patients received

passes of a few days duration between the times of rating and testing, but returned in time to be included in the sample.

The relative fluidity of the reactive patient population imposed difficulties in obtaining the sample. On the other hand, this served as an incidental indication of the validity of the scale as a prognostic instrument.

As the patients were tested on the pursuit rotor, they were also rated by the examiner in regard to apparent degree of psychosis at that time. An example of the scale used is included in the appendix. The ratings were accomplished simply by checking the point on a straight line at which the particular patient seemed to fall and they were made on the basis of the patients' behavior during the testing and conversational offerings during the two five-minute rest periods. It should be emphasized that these ratings were more or less subjective on the part of the examiner, and no attempt was made to probe into the patients' deeper feelings or thought processes.

After all patients had been rated, the rating sheets were ranked in order from least to greatest amount of psychosis apparent. No attempt at quantification was made. Next, White's Rank Test (40) was applied to determine whether or not patients in one of the schizophrenic categories had appeared more disturbed than the other. Results of these calculations are given in Table 1. As can be seen, the difference did not approach statistical significance and it would

not have done so even if a one-tailed test had been applied. In other words, both groups of patients appeared to the examiner to be about equally disturbed.

It should also be noted that some of the patients in this sample were being treated with tranquilizing drugs. Amount and rate of drug dosage were in accordance with the regular hospital treatment program and were prescribed by the ward physicians. A check was made as to whether or not this treatment could be expected to vary with respect to the two schizophrenic groups in this study. Ten subjects each were chosen at random from the two groups, and their medication records were checked for the week preceding testing. Four process patients and three reactives were being given Thorazine. The average daily dosage was 300mg. in each case. One patient in each sample was being given Trilafon with the process patient being given 12 mg. daily and the reactive 8 mg. Six reactives and five process patients were not given medication during the week preceding testing. From this small sample, it would appear that the two groups were not given differential drug treatment.

Twelve normal subjects were run at 50 rpm in order to be sure that the reduced rotor speed per se introduced no new variables. The normal group was composed of hospital employees comparable in age to the psychotic group.

All testing on the pursuit rotor was done by the investigator between the hours of 9:00 AM and 4:00 PM.

Each of the two main groups (process and reactive) was subdivided into four subgroups making eight in all with 10 subjects in each group. The conditions of spacing under which the four groups from each category practiced were: D-D-M; D-M-M; M-D-M; and M-M-M. For purposes of easy reference, the reactive schizophrenic group will hereafter be referred to as R-D-D, R-D-M, etc. While the process schizophrenics will be referred to as P-D-D, etc. Since all groups were massed for their final session, only the first two practice conditions differentiate the groups. Instructions to subjects were identical to those given in the preliminary study. The first session in each case consisted of twelve 30-second trials; the second of eighteen 30-second trials; and the third of six 30-second trials. The third session was massed trials for all subjects. The normal group practiced under conditions of M-D-M for the same time periods as did the psychotic S's. Time on target was recorded every 10 seconds for the first two minutes of sessions 1 and 2, and for all of session 3. Otherwise, it was recorded every 30 seconds, and the method of accomplishing this was the same as that previously used in the preliminary investigation. Subjects in each of the two main categories were roughly matched in assignments to the four practice conditions on the basis of their performance during the first 30 seconds of practice. This was accomplished by a quick estimation and without interrupting the practice in any way. The

graphs in Figures 5 and 6 and the statistical analysis in Table 2 (see Results section) give evidence that the groups were well matched at the beginning of practice. Scores of time on target of the normal sample were converted into percentage of time on target in order to facilitate comparisons with other published data.

Analysis of variance was used as the statistical technique for comparisons whenever appropriate. A fundamental condition for the validity of this procedure is that the mean squares be independent. This condition is not met in the case of percentages. Calculations of differences between the psychotic groups were therefore made from the raw scores rather than from percentage scores. In each case where analysis of variance was used, a test of homogeneity was first applied as recommended by Edwards (40) to assure that the data were sufficiently homogeneous to make the F test applicable.

In cases where analysis of variance indicated that significant differences existed between the groups, Tukey's Gap Test (40) was applied. This test tells how great a difference has to be in order to be considered statistically significant at a pre-determined level. When mean scores are arranged in order of magnitude, gaps between them can then be easily checked to determine whether or not they are statistically significant. In the present study, statistical significance was arbitrarily placed at the .05 level unless it is

otherwise indicated.

RESULTS

The mean scores of time on target of the normal sample are presented in Figures 3 and 4. Inspection of the curves reveals that, although this group started at a higher level and continued to achieve better scores than samples run at 60 rpm, the same variables appear. Massed practice during learning was characterized by rapid growth in skill at first. Then inhibitory factors set in, the curve became negatively accelerated, and then took on a downward trend. After a five-minute rest, significant reminiscence was shown, indicating that an appreciable amount of inhibition had dissipated over rest. The post-rest practice periods were marked by an initial spurt of warm-up, and then continued in a pattern characteristic of the conditions of spacing or massing. It can be concluded that the slower rotation speed of 50 rpm does not eliminate any of the usual variables encountered in motor learning situations and does not introduce unusual variables into the situation.

TABLE 1

White's Rank Test Applied to Estimated Degree of Psychosis in Process and Reactive Patients

Group	Sum of Ranks	Mean Rank	Standard Deviation	Z score	P .10	P .05
Process	1765	1620	103.75	1.40	1.65	1.96
Reactive	1475					

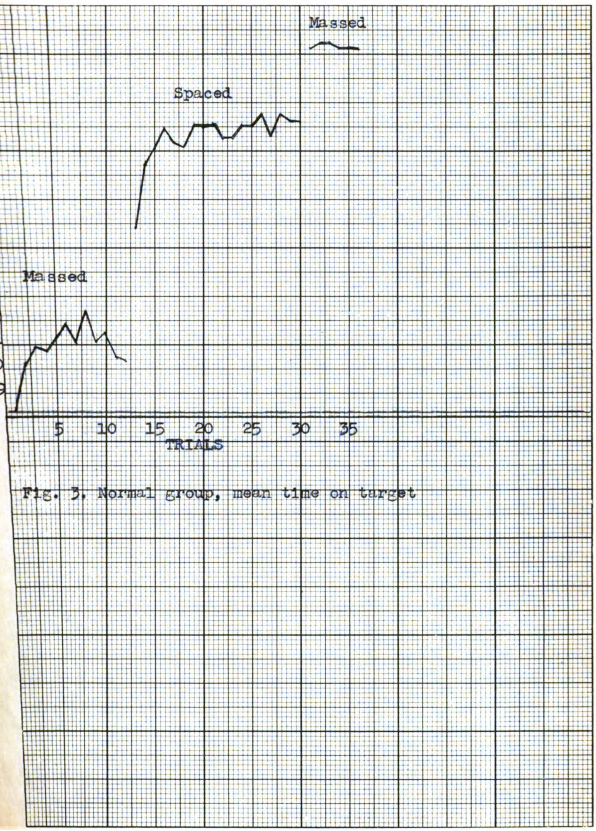

Fig. 3. Normal group, mean time on target

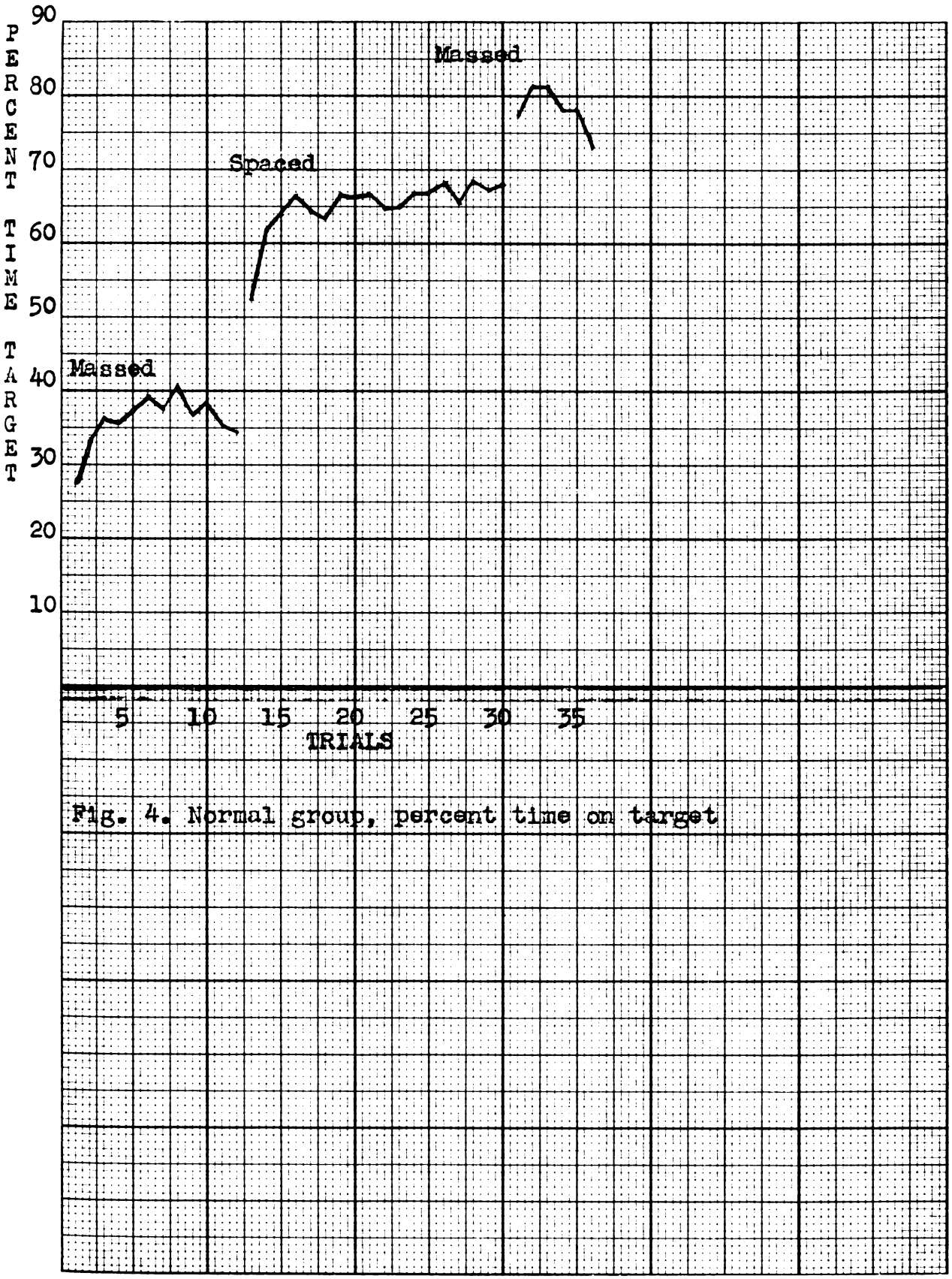

Fig. 4. Normal group, percent time on target

As a guide in considering the results obtained from the psychotic samples, several specific questions were formulated with respect to each dependent variable. These questions are:

1. Do process and reactive schizophrenics differ regardless of conditions of practice?
2. Do they differ on massed practice when this is the initial practice condition?
3. Do they differ on spaced practice when this is the initial practice condition?
4. Do they differ on spaced following spaced practice (D-D)?
5. Do they differ on massed following spaced practice (D-M)?
6. Do they differ on massed following massed practice (M-M)?
7. Do they differ on spaced following massed practice (M-D)?

The dependent variables by means of which the two psychotic samples were compared were: scores of time on target, reminiscence, temporary inhibition, conditioned inhibition, amount of warm-up decrement, and length of time taken to warm up or regain set after a rest. Each of these variables was discussed in general terms in a preceding section. Operational definitions of each as they are used in the present study are given together with the results in each case.

Time on target was simply the scores recorded for each subject. Scores for all trials within a designated period were summed for each subject. In this way, cumulative scores for each were obtained for the period being investigated.

Mean times on target for all practice sessions of the psychotic samples are presented graphically in Figures 5 and 6.

Analysis of variance of time on target scores for the first practice period is presented in Table 2. Since all

TABLE 2

Analysis of Variance of Total Time on Target, Last Half of Practice Period 1

Source of variation	Sum of squares	df	Mean Square	F	P
Between conditions	8724.08	1	8724.08	13.10	.01
Between diagnoses	571.27	1	571.27	0.86	NS
C x D interaction	2733.13	1	2733.13	4.10	.05
Within groups (error)	50616.52	76	666.01		
Total	62645.00	79			

For df 1 and 76, $F_{.05} = 3.97$ $F_{.01} = 6.98$

groups were matched at the beginning of practice, the analysis of variance which is presented here was calculated over the second half of the practice period. This approach was chosen since it is the conventional method of bringing out more clearly any differences in scores associated with different conditions of practice. It should also be noted that only four groups are involved in this analysis since each psychotic group was divided equally into spaced and massed groups for the first practice session.

A graphic presentation of the scores of these four groups is given in Figure 7.

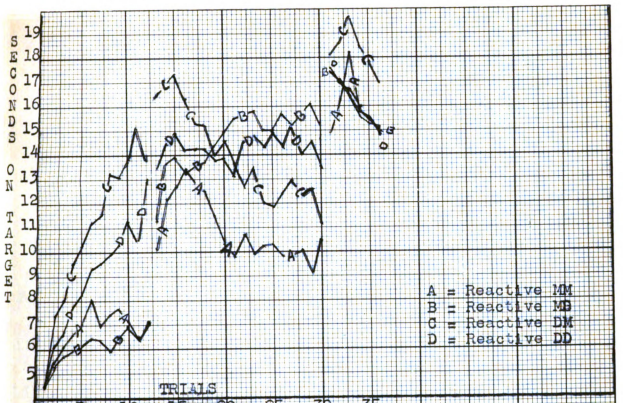

Fig. 5. Reactive groups, mean time on target.

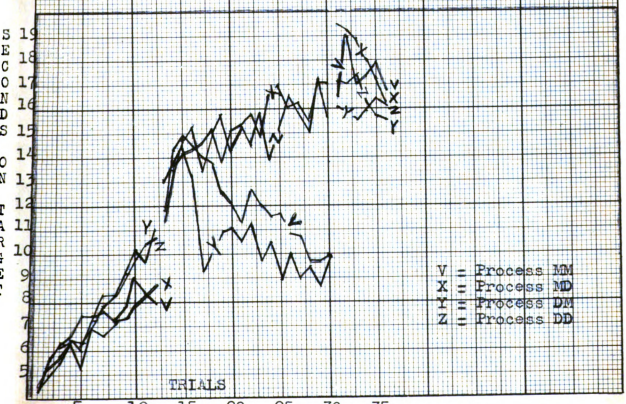

Fig. 6. Process groups, mean time on target

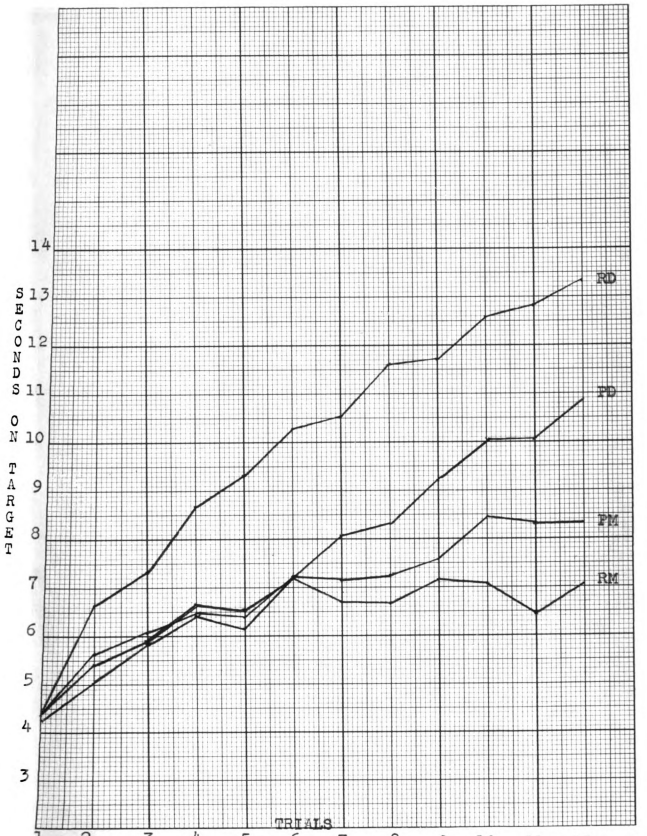

Fig. 7. Mean times on target, first practice period

The superiority of groups practicing under distributed conditions over groups practicing under massed conditions is clearly evident, and this superiority is significant beyond the .01 level ($F = 13.10$ with 1 & 76 df). This phenomenon was one of the first observed to be typical of normal subjects in motor learning tasks. It's appearance in the psychotic samples is therefore to be expected.

Of more importance to the present study is the effect of spacing and massing upon the two psychotic types. There proved to be a significant interaction effect between type of psychosis and condition of practice. The reactives responded quite differently under the two conditions of practice while the process groups showed no statistically significant difference between conditions. Whereas the RD group scored higher than any of the others, the Rm group's performance fell below that of all the others'. Tukey's gap test for significance of differences between adjacent means (Table 3) indicates that the RD groups' performance was better than the PD group's beyond the .05 level of significance. The difference between the PM and RM groups was in the opposite direction, but was not statistically different. A striking feature of the data is that, while the PD group surpassed the PM group in performance as would be expected, the difference between the groups did not reach statistical significance in this first practice period.

Partial answers to our first three questions are as

TABLE 3

Tukey's Gap Test Applied to Differences in Time on Target Last Half of Period 1

Groups	Mean time on target	Difference
RD	73.10	
PD	56.56	16.54*
PM	47.27	11.29
RM	41.02	6.25

A significant gap = 16.21

follows:

1. No significant differences in motor performance appeared between the two psychotic types per se (Between types F = 0.86 with 1 & 76 df).

2. The psychotic groups did not differ significantly under initial massed practice.

3. Reactives were significantly (.05) superior to process on initial spaced practice.

Table 4 presents the analysis of variance of time on target scores for the second practice period. Again analysis was computed on the last half of the practice period in order to test more adequately the relationships involved. The reasoning here is that after the first few minutes of post-rest practice (about 2½ to 3 minutes for normal subjects) differences due to reminiscence and warm-up have been compensated for, and relationships then become more stable. In addition to this, the last cross-over of performance curves

TABLE 4

Analysis of Variance of Total Time on Target, Last Half of Practice Period 2

Source of variation	Sum of squares	df	Mean square	F	P
Between conditions	35295.66	3	11765.22	5.93	.01
Between psychotic types	0.00	1	0.00	0.00	NS
C x T interaction	3891.55	3	1297.18	0.65	NS
Within groups (error)	142922.45	72	1985.03		
Total	182109.66	79			

For df 3 & 72, $F_{.05} = 2.74$ $F_{.01} = 4.08$

arising from changes in conditions had occurred by the mid-point of the practice period (Adams & Reynolds (2), Denny (34), Frisbey (45), and Reynolds & Adams (99) have found that the performance curves of normal subjects practicing under similar conditions come together and merge into a single curve after about six minutes regardless of previous conditions of practice).

As can be seen from Table 4, differences arising from conditions of practice were significant beyond the .01 level. Interaction between psychotic categories and conditions of practice were no longer significant, however, and differences arising from process versus reactive schizophrenia *per se* were nil. The significant F primarily reflects the fact that the groups under massed practice did not merge with each other in either psychotic sample. The RDM group scored consistently higher than the RDM group, while the PDM group

scored consistently lower than did PMM. These differences were tested by means of the *t* test, and the results are given in Tables 5 and 6. Group RDM surpassed group RMM at a level of significance beyond .01. Group PDM fell below group PMM, but not to a statistically significant degree.

TABLE 5

t Test of Differences in Time on Target Between Groups RDM and RMM, Last half of Practice Period 2

	RDM	RMM
Mean	111.78	90.58
Standard error of difference between means	3.37	
t	6.29*	
df	18	
P	.01	

For 18 df, $P_{.01} = 2.88$

TABLE 6

t Test of Differences in Mean Time on Target Between Groups PDM and PMM, Last Half of Practice Period 2

	PMM	PDM
Mean	98.89	87.47
Standard error of difference between means	19.36	
t	.59	
df	18	
P	NS	

Another kind of difference is seen in the performance of the two DD groups. Whereas during the first practice period the RDD group had outgained the PDD group by a significant (.05) amount, the situation appears to be reversed in the second period. The performance curve of RDD appears essentially flat while group PDD seems to rise in a relatively straight line. This impression was tested by a method suggested by Edwards (39). Gains for each group between the first minute of practice in the second period and the last minute of the same session were computed and the differences in gain subjected to a t test. Results, presented in Table 7 demonstrate that, during this practice period, group PDD outgained group RDD by an amount significant beyond the .05 level.

TABLE 7

t Test of Differences in Gains Between Groups RDD and PDD From First to Last Minute of Practice Period 2

	RDD	PDD
Mean	12.60	18.14
Standard error of difference between means	2.32	
t	2.39*	
df	18	
P	.05	

For df 18, $P_{.05} = 2.10$ $P_{.01} = 2.88$

Answers to our original seven questions which would be made on the basis of the second practice period scores are:

1. The two schizophrenic groups showed no difference in time on target attributable to the psychotic category *per se* ($F = 0.00$).

2. They differed to a significant (.05) degree in reaction to DD conditions of practice with process groups outgaining the reactives.

3. They differed to a significant (.01) degree in response to DM conditions. Reactives showed an elevation effect when compared to the MM group, and the process subjects showed a disruption of performance.

4. They showed no significant differences in response to MD conditions. Both groups showed something of an elevation effect when shifted to D conditions and slightly surpassed the groups that had been under spaced conditions from the beginning.

Time on target during the third, and last practice period when all subjects were under the same conditions of practice was subjected to analysis of variance, and the results are presented in Table 8. As can be seen no significant differences in time on target persisted at this time. All groups had arrived at a comparable level of performance.

Reminiscence, or gain over rest, was operationally defined in this study as the difference in time-on-target scores between the last 30 seconds of pre-rest practice and the first 30 seconds of post-rest practice. To obtain reminiscence scores, differences in performance were calculated

TABLE 8

Analysis of Variance of Time on Target
During Practice Period 3

Source of variation	Sum of squares	df	Mean square	F	P
Between conditions	162.60	3	54.20	0.05	NS
Between diagnoses	1.07	1	1.07	0.00	NS
C x D interaction	3128.92	3	1042.97	0.93	NS
Within groups (error)	81059.25	72	1125.82		
Total	84351.84	79			

individually for each subject. Analysis of variance of reminiscence scores over the two five-minute rest periods are given in Tables 9 and 10. As can be seen, the only difference that proved to be statistically significant arose from different conditions of practice during the second practice period. These were in the usual direction with

TABLE 9

Analysis of Variance of Reminiscence
Over 1st Rest Period

Source of variation	Sum of squares	df	Mean square	F	P
Between conditions	46.57	3	15.52	2.06	NS
Between diagnoses	0.04	1	0.04	0.01	NS
C x D interaction	31.25	3	10.42	1.38	NS
Within groups (error)	542.11	72	7.53		
Total	619.97	79			

For df 3 & 72, $F_{.05} = 2.74$ $F_{.01} = 4.08$

TABLE 10

Analysis of Variance of Reminiscence
Over 2nd Rest Period

Source of variation	Sum of squares	df	Mean square	F	P
Between conditions	222.45	3	74.15	6.59	.01
Between diagnoses	6.80	1	6.80	0.60	NS
C x D interaction	64.95	3	21.65	1.92	NS
Within groups (error)	810.08	72	11.25		
Total	1104.28	79			

For df 3 & 72, $F_{.05} = 2.74$ $F_{.01} = 4.08$

subjects massed in the second practice period showing more reminiscence than subjects who had been assigned to distributed practice during the preceding period.

It is worth noting, however, that the performance curves in Figure 5 depict the RDD group as showing an appreciable amount of gain over the second rest period in comparison with the other groups. Over the first rest period, they showed a negligible amount of gain. This is a bit of evidence in support of the interpretation to be developed later that group RDD did not find apaced conditions noxious during the first period, but did react negatively to being continued on spaced conditions. The two psychotic groups did not appear to differ in any other way with respect to reminiscence.

Amount of warm-up decrement was operationally defined as the difference between the first 30-second post-rest trial

and the peak score of the post-rest spurt. Warm-up decrement, like reminiscence, was computed separately for each of the 80 subjects.

Analysis of variance of warm-up decrement for the two post-rest practice periods are presented in Tables 11 and 12.

TABLE 11

Analysis of Variance for Amount of Warm-Up Decrement at the Beginning of Practice Period 2

Source of variation	Sum of squares	df	Mean square	F	P
Between conditions	13.09	3	4.36	1.99	NS
Between diagnoses	1.28	1	1.28	0.58	NS
C x D interaction	5.11	3	1.70	0.78	NS
Within groups (error)	157.79	72	2.19		
Total	177.27	79			

For df 3 & 72, $F_{.05} = 2.74$ $F_{.01} = 4.03$

TABLE 12

Analysis of Variance of Warm-Up Decrement at Beginning of Practice Period 3

Source of variation	Sum of squares	df	Mean square	F	P
Between conditions	12.44	3	4.15	2.99	.05
Between diagnoses	0.00	1	0.00	0.00	NS
C x D interaction	6.61	3	2.20	1.58	NS
Within groups (error)	100.25	72	1.39		
Total	119.30	79			

For df 3 & 72, $F_{.05} = 2.74$ $F_{.01} = 4.08$

again, the only differences of statistical significance were those brought about by the conditions of practice. The two groups undergoing massed practice for both preceding practice sessions showed more warm-up than did groups with spaced practice experience. Presumably, groups under spaced conditions would have had more practice in resuming the task after a rest, so the observed difference is in the expected direction. This is also the usual finding in studies utilizing normal subjects with the exception of the Frisbey study (45) after which the present study is chiefly modeled. No differences in amount of warm-up decrement were found between the two psychotic groups. This finding is worthy of special note since it will be referred to in discussing the length of time taken to warm up by the two psychotic groups.

Time required to warm-up was operationally defined as the number of 10-second units of practice taken to reach the peak of the post-rest spurt in performance. Scores for each subject were arrived at by counting. Since measurements were not made for periods under 10 seconds, a normal distribution of scores could not be expected. Analysis of variance could not, therefore, be appropriately applied to these data. Instead, a simple sign test recommended by Edwards (40) was utilized. The Z-scores presented in Table 13 are corrected for continuity since it is to be expected that the underlying variable, (length of time to warm up) was normally distributed. This correction has, in every case, the effect of lowering

TABLE 13

Time to Warm Up, Beginning of Second Practice Period Z-Scores for Differences Between Groups

	PMM	PMD	PDD	PDM	RMM	RMD	RDD
PMD	0.00						
PDD	1.27	0.32					
PDM	2.22**	0.32	-0.32				
RMM	0.63	0.63	-1.58*	-0.95			
RMD	0.00	0.95	-0.32	-0.95	0.00		
RDD	2.00**	2.00**	0.32	0.00	0.32	1.58	
RDM	5.70***	2.00**	0.95	0.00	0.95	0.95	0.00

* Significant beyond .10 level.
** Significant beyond .05 level.
*** Significant beyond .01 level

A minus Z-score indicates that the group in the left hand column took longer to warm-up than the group in the top row with which it is compared.

Z score of all PM - all RM = 1.79*
Z score of all PD - all RD = 0.67
Z score of all P - all R = 1.90*

the probability of finding significant differences. Inspection of Table 13 reveals that, when all process patients are compared with all reactive patients, the process group took longer to warm up. This difference is significant beyond the 10 percent level of confidence but does not reach the .05 level. Beyond this, the differences found are not meaningful for this study. The groups which had practiced under massed conditions took longer to warm up or regain set than did the distributed-practice groups. Normal subjects show the same

effects from spacing and massing.

Temporary inhibition was operationally defined as reminiscence plus warm-up decrement. This measure was obtained by adding together the scores for each subject. The aim here, of course, is to obtain an estimate of what the gain over rest (assumed to be from dissipation of temporary inhibition) would have been had there been no need to warm up. Analysis of variance of temporary inhibition dissipated over the two rest periods are given in Tables 14 and 15. Over the first rest period, as can be seen, there was a difference at the .01 level of significance between groups practicing under massed and spaced conditions. This difference is in the usual direction with massed practice groups showing the most inhibition dissipated over rest. Differences due to psychotic type or to interaction of psychosis and conditions of practice did not approach significance.

TABLE 14

Analysis of Variance of Temporary Inhibition Dissipated Over the First Rest Period

Source of variation	Sum of squares	df	Mean square	F	P
Between conditions	117.85	3	39.28	4.43	.01
Between diagnoses	1.29	1	1.29	.15	NS
C x D interaction	15.78	3	5.26	.59	NS
Within groups (error)	638.15	72	8.86		
Total	773.07				

For df 3 & 72, $F_{.05} = 2.74$ $F_{.01} = 4.08$

TABLE 15

Analysis of Variance of Temporary Inhibition Dissipated Over Second Rest Period

Source of variation	Sum of squares	df	Mean square	F	P
Between conditions	281.72	3	93.91	7.83	.01
Between types	10.73	1	10.73	0.89	NS
C x T interaction	82.57	3	27.52	2.29	NS
Within groups (error)	864.24	72	12.00		
Total	1239.26	79			

For df 3 & 72, $F_{.05} = 2.74$ $F_{.01} = 4.08$

Over the second rest period, the same results were obtained with a single exception. The differences due to interaction barely missed significance at the .05 level. Inspection of Figures 5 and 6 again reveals that the RDD group was the only one apparently deviating from normal expectancies with respect to gain showed over the second rest period. This suggests that the interaction effect arose largely from the improved performance of the RDD group. Normally, spaced-practice subjects are expected to show little, if any temporary inhibition.

Conditioned inhibition was operationally defined as the difference between spaced-practice subjects and massed-practice subjects on the first post-rest 30-second trial with warm-up decrement added to the score in each case. Statistical analysis in this case consisted of applying the *t* test to differences between the two groups from each psychotic

sample. That is, group PD was compared to group PM and group RD was compared to group RM. For the first trial of practice period 2, there were 20 pairs of subjects in each psychotic category. The first trial of period 3 provided 10 pairs each of reactive and process patients for comparison. The results shown in Tables 16 and 17 demonstrate that a statistically significant amount of conditioned inhibition was found after the first practice session for both groups. At the beginning of the third practice session, however, conditioned inhibition was not found in either case.

TABLE 16

t Test for Conditioned Inhibition Following First Practice Period

	RD	RM	PD	PM
Mean	15.12	10.69	13.11	11.60
Standard error of difference between means	1.61		1.51	
t	2.75		1.00	
df	18		18	
P	.05		NS	

For 18 df, $P_{.05} = 2.10$ $P_{.01} = 2.88$

TABLE 17

t Test for Conditioned Inhibition Following Second Practice Period

	RDD	RMM	PDD	PMM
Mean	18.22	16.51	17.11	16.54
Standard error of difference between means	4.93		1.79	
t	0.35		0.32	
df	8		8	
P	NS		NS	

For 8df, $P_{.05} = 2.31$ $P_{.01} = 3.36$

DISCUSSION

This experiment began in an attempt to gain more information about process and reactive schizophrenics. A study of modes of adjusting in a motor learning situation was chosen as a means of obtaining an objective cross-sectional sample of their adjusting processes. Variables derived from studies of pursuit rotor performance by normal subjects ofofered convenient tools for accomplishing this purpose and were therefore adopted in the present investigation.

The very fact that the investigation was undertaken implies, of course, that differences between the two psychotic groups were expected, although no specific hypothesis were formulated. Indications that differences do, indeed, exist are given by the learning curves of the psychotic subjects under the various conditions of massing and spacing of practice. Statistical evidence gives considerable assurance that these differences did not happen by chance. As will appear later, there was also a high degree of consistency among the various factors.

A finding of primary importance was that all the psychotic groups arrived at a comparable level of skill at the task after 18 minutes of practice. This neatly demonstrated that the differences cannot be attributed to a deficit in psycho-motor performance by one of the groups. As well as providing corroborative evidence for the same conclusion

arrived at by Reisman (98) in his study, this finding gives added weight and meaningfulness to the results of the present investigation.

Performance of the subjects during the first practice period indicated that the reactive patients were more strongly ormore immediately affected by differences in the environmental situation. The reactive group under spaced conditions surpassed all other groups at a significant level while the RM group fell below all the others. That the difference arose from immediacy of response on the part of the reactives was indicated by several independent lines of evidence in the later practice periods. First, by the end of the second practice period there were no longer any statistically significant differences between the PDD and RDD groups or between the PMM and the RMM groups. As a matter of fact, both process groups which were spaced for the second practice period now slightly surpassed both reactive groups under the same conditions. It will be recalled that in the first session, the process groups had been significantly lower and that the PDD group made significantly more gain during practice period 2. Another line of evidence is found in the longer time taken by the process group to warm up or regain their set after a rest. That this was truly a relative slowness in regaining set is indicated by the fact that the total amount of warm-up shown by the process patients did not differ significantly from the amount shown by the

reactives. In other words, it appears that the process subjects simply took a little longer to arrive at the same stage reached more quickly by the reactives. Still another bit of evidence is supplied by the lack of difference in reminiscence over the 1st rest between the two main psychotic groups. Associated with this, of course, is also the lack of difference in temporary inhibition dissipating over rest between practice periods 1 and 2. This would indicate that the process patients were not experiencing massed conditions as either more or less noxious than the reactives did.

Upon further analysis of the data, it begins to appear that there were not only differences in speed of adapting to the task, but also differences in kind. Early indications of this were given by the elation effect shown by reactive patients upon any change of conditions, even to more noxious ones. This suggests an attempt at escape; a pattern of flight from present circumstances into new situations. Added liklihood for this interpretation was provided by comments of RDD patients during their second period of spaced practice that they were "bored", "tired", etc. Their performance bore out their verbalizations quite well since this group, superior in performance in session 1 when the task was novel, fell below all the other distributed-practice groups in session 2.

Following a second five-minute rest, the subjects were told that the next session would be massed. The RDD group

then demonstrated that they were not deficient in either ability or learning. They showed a reminiscence effect that was comparable to that shown by the previously-massed groups, then continued to perform as well as the other seven groups.

The same interpretation of a flight reaction could explain the performance of the RDM group. Upon being shifted from D to M conditions for the second session, they showed an elevation effect and surpassed the RMM group by a significant amount. The probability of an aversive response to the on-going state of affairs is pointed up more forcefully by the fact that, during the first practice session, groups RDD and RDM were statistically indistinguishable.

While these shifts were taking place, the RMM group continued to be lower than any other. Following the second five-minutes rest, however, it became evident that massing of practice throughout had not been reacted to by this group as being oppressive. They showed a moderate amount of reminiscence over rest, a moderate amount of reactive inhibition, and they warmed up quickly in the third practice period. They also performed at a level that was not significantly different from the other seven groups when all were practicing under the same conditions in practice period 3.

At first glance, we seem to be faced here with a perplexing contradiction. The RDD group, under presumably least noxious conditions, reacted in the second practice

period as though these conditions were oppressive. At the same time, the RMM group reacted as though massed conditions were not oppressive, and there were even indications that these conditions were in some way rewarding. Furthermore, assurance that these two groups were equal in ability is given both by the very early learning trials and by the final practice period scores.

Our previously-used interpretation of a flight reaction on the part of reactive schizophrenics explains this seeming paradox. If it is assumed that both groups (RDD and RMM) are impelled toward escape from a distressing life situation, the rest follows logically. It could be predicted that massed conditions, being more demanding, would therefore provide a more nearly complete escape. The massed practice group would then obtain secondary gains from the "noxious" conditions. On the other hand, distributed practice could be expected to offer relief during early learning, but then to provide a less and less satisfactory avenue of escape as skill progressed. Subjects would then be expected to reach satiation more quickly, and performance would fall off. This is, of course, exactly what was found in the two groups' performance.

The reactive patients' tendency to quickly become satiated or bored when an activity no longer furnishes diversion, hypothesized above, may also be a partial explanation for observation that schizophrenics seem unable to

maintain set during a prolonged task (51, 57, 58, 59, 60, 76, 87, 104, 106).

At this point, it may be noted that a generalized reaction pattern of attempted escape from an oppressive situation could also be used to explain the faster warm-up of reactive patients. They, being in a "high drive", "ready for action" state would be expected to enter more quickly into any activity that offered itself.

This interpretation of the data is consistent with the learning theory principle that, given sufficient drive to elicit an activity, differences in drive or motivation affect amplitude of response but do not affect learning. It will be recalled that the various manipulations of spacing and massing of practice had significant effects upon the performance of the subjects. Nevertheless, all groups achieved at the same level during the final three minutes under identical conditions.

These findings are in accord with those of Reisman (98) who concluded that "...reactive schizophrenics, unlike process, appear to be avoiding a noxious environment".

In a theoretical article published as the present investigation was nearing completion, Mednick (89) also suggested "...that acute schizophrenics are organisms in a state of heightened drive". As Mednick also points out, a heightened drive state on the part of "acute" patients is consistent with the physiological findings cited at the

beginning of the present report (36, 46, 47, 48, 49, 87).

Something like a converse situation seems to obtain with respect to the process schizophrenics. They entered into the new situation less quickly, but then improved steadily as long as the conditions were unchanged. With a shift to the less noxious spaced conditions of practice they, like the reactive sample, improved in performance. Unlike the reactives, however, process patients shifted from D to M showed a disruption of performance and process patients continued on D conditions continued to improve in performance. As was mentioned earlier, during the second practice period, the PDD group slightly surpassed the RDD group in performance whereas in the first period, the RDD group had scored higher by a significant amount.

Three different interpretations might be given to the behavior of the process groups. First, it might be argued that they simply were at a homeostatic or "low drive" state. Thus they would be responding more or less like normal subjects to the stimuli present in their external environment. In this case, no special habit patterns of responding would be involved. Another possibility is that the process schizophrenics were responding in the same way as the reactives, but with a lag in the onset of the various reactions. The third possibility is that a difference in habitual modes of adjusting exists between the two psychotic groups. These possible interpretations will be discussed separately.

That the process patients were responding like normals seems to be contraindicated by several factors. First, their mean scores were considerably below those of normal subjects. This argument will become more compelling as it develops that all differences isolated by the present study can be adequately explained through the actions of psychological factors. Secondly, the small difference between scores by the PM and PD group in the first session is not found among normal subjects. In the third place, the disruptive effect on group PDM of being shifted to massed conditions is not ordinarily found among normal subjects. Another factor making homeostasis no more probable for the process group than for the reactives is that both groups were controlled for duration of psychosis. Although the process group, by definition, "grew" into their psychosis more slowly than the reactives, no member of either group had been overtly psychotic for more than a year. Subjective evidence in the same direction is provided by the investigator's impression of the process patients as being as acutely psychotic as were the reactives.

The second possibility, that there was simply a lag in adaptation by the process group, is not so easily disposed of. It may be that with longer prolongation of practice, the process groups would show the same performance characteristics as those shown more quickly by the reactive sample. Only a very considerable extension of practice could furnish conclusive evidence for or against this possibility.

The fact remains, however, that no indication of such a shift was obtained in the present investigation. Furthermore, indications in support of the remaining interpretation did appear in the data.

That a difference in habitual modes of adjusting brought about the observed differences in performance seems probable. While the reactive patients seemed quite clearly to be showing a response of flight from the existing situation, the process patients' responses were more suggestive of an unwillingness or inability to venture into a new activity. Thus they entered a novel situation more slowly and tentatively. With success, they became more and more involved in the task, and showed more of the usual reactions with respect to the experimental variables.

This concept also explains the otherwise peculiar response of the PDM group during the second practice session. They had experienced success under spaced conditions and then were shifted to a more difficult condition. Their reaction then was one of being thwarted and of drawing back from the situation. Consequently, performance was disrupted. With further practice, they recovered and eventually achieved the same degree of skill as the other psychotic subjects.

All four groups of process schizophrenics followed this general pattern of initial slowness of entering into the task, followed by a gradual increase in commitment as they experienced success and became more secure in the situation.

It may be concluded that these process patients had not reached a comfortable homeostatic balance. Rather, their hesitancy about venturing into activity gave evidence of their being anxious and ill-at-ease with their life situations. A major difference between the groups seems to lie in the process patients reluctance to expose themselves to potentially threatening situations, while the reactives showed eagerness to change their current circumstances.

The present findings with respect to process schizophrenics are in agreement with the physiological findings of DeVault (36) in his study of process and reactive patients and Williams' (119) study of "early chronic" schizophrenics. They are also in agreement with some other studies of motor behavior in "chronic" schizophrenia (76, 87), and with Reisman's findings regarding process schizophrenics (98).

In the study just cited, Reisman concluded that the response pattern of his process group on a different kind of task was best described as one of habitual withdrawal from psychologically neutral stimuli. This description would seem to fit the present process group fairly well. In the Present case, however, the response seemed to be more one of guardedness and readiness to withdraw rather than immediate and non-selective withdrawal from all stimuli. This difference may well be brought about by differences in duration of the psychosis. Reisman chose subjects whose current hospitalizations were for less than one year. Presumably,

previous hospitalizations were more or less ignored. The present study was confined to subjects whose psychoses were less than one year in duration. It seems possible, then, that Reisman's subjects simply showed a further development of habit patterns more or less incipient in the present sample.

Our present evidence, then, seems to be most reasonably interpreted by ascribing different habitual modes of adjusting to the two psychotic groups. The pattern followed by the reactives was one of unrest in their present circumstances and a readiness to move into new situations. This might be described as a flight or withdrawal from their internal environments. The process patients, on the other hand, demonstrated hesitancy and slowness in entering into a new situation; a sort of tentative withdrawal from the external environment.

Limitations of Conclusions

The present investigation, being confined to variables in a single motor learning situation, generalizations concerning other areas must be held tentatively. It is worth noting, however, that these results are consistent with findings from studies utilizing different tasks (50, 76,98), with some conditioning studies (23, 42, 87, 94, 126) and with physiological evidence (36, 46, 47, 48, 49, 119). The data also provide reasons for believing that the observed differences arose from differing habits of reacting or

generalized attitudes rather than from factors specific to motor learning.

Conclusions regarding permanent or conditioned inhibition are somewhat open to question. The accepted measure of conditioned inhibition is calculation of the difference remaining between spaced subjects and massed subjects in the first post-rest trial. The assumption here is that temporary inhibition does not accumulate during spaced practice, therefore conditioned inhibition cannot be generated under these conditions. Then, since temporary inhibition in massed subjects dissipates during rest, any remaining difference will be due to conditioned inhibition in the massed practice group. Since a demonstrable amount of temporary inhibition did occur in the RD group, the above assumptions were obviously not met. Therefore we have no good evidence whether or not conditioned inhibition was generated in the present samples to differing degrees.

Nevertheless, it is worth noting that significant amounts of conditioned inhibition were shown after the first practice session by the reactive groups. By the end of the five-minute rest following the second practice session neither group showed a significant amount of conditioned inhibition. Something like this phenomenon was found by Ammons (10) in a study of normals under prolonged practice. After all groups were approaching their ceiling performance, differences tended to disappear.

As was stated, this finding must be viewed with reservation with respect to determining whether or not conditioned inhibition was actually present. Despite this reservation, some conclusions can legitimately be drawn from the finding. The outstanding fact is that differences between the D and M groups of both psychotic categories had disappeared after only 18 minutes of practice. Not only were there no differences during the first post-rest trial of period 3, but also none for the final practice session considered as a unit.

This might be interpreted as an indication that already established patterns of reacting were so firmly intrenched in these psychotic samples that they interfered with "normal" reactions to stimuli. Normally, of course, the DD groups would be expected to surpass MM groups due to conditioned inhibition in the latter.

Perhaps it would be more justified to conclude more specifically that, for some reason, DD conditions were reacted to as being as noxious as MM conditions.

Implications

Obviously, replication of all or part of the present study with predictions that the same major phenomena would appear would aid in evaluating the present findings. Although these results are in agreement with several differing lines of investigation, there have been relatively few studies spearating process and reactive schizophrenics as such. For this reason, comparability of samples is often

questionable. It is possible to find supportive evidence for almost any proposition among the mass of often-contradictory literature on "schizophrenia" considered as an entity.

A considerable extension of the duration of practice would also be of interest as a further check on the consistency of the observed trends. Since, in the present study, it was found that selection of subjects was most arduous and time-consuming, it would seem to be in the interests of efficiency to make every possible use of subjects once they are identified.

The present findings could account for the better prognosis for reactive patients without recourse to physiological differences. The fact that reactives respond more quickly to environmental differences would make them more amenable to therapeutic manipulations. This could be expected to be a spiraling thing, so that even small differences in rate of responding would bring about an ever-increasing gap between the two groups analagous to "fast learners" and "slow learners" in ordinary school situations.

In addition to rate of responding, the reactives' apparently greater drive level and their greater ability to enter into a new situation could be expected to lead them to try more varied adjusting techniques. Thus, their prognosis for either spontaneous remission or for therapy would be better if it is assumed that movements towards mental health will be rewarding to them and thus more apt to be retained

or repeated. Even without such an assumption, it could be predicted that the reactive schizophrenics' trial behavior would most probably lead to some kind of change, and the change would be for the better at least part of the time.

Another implication concerning the reactives is that they seem disturbed by something in their own life situations. This at least presents the possibility that identification and amelioration of the disturbing circumstances may relieve their conditions.

Another implication is that, since reactives seem to be fleeing a noxious life situation, early discharges and passes to return to the conditions associated with onset of psychosis should be avoided. Although, as a group, they recover quite quickly when hospitalized, more time would be needed to change habit patterns and attitudes. Longer hospitalizations for these patients might cut down the "return rate", or re-admissions, considerably.

In short, the present results point to the hardly-surprising conclusion that reactive schizophrenics should be more amenable to conventional psychotherapeutic approaches, to environmental manipulations, and to spontaneous remissions. It might be added that tranquilizing drugs could also be expected to be more efficacious for the reactives by calming and controlling their flight reactions, and enabling them to continue longer at a task.

Implications with respect to the process group are not

so optimistic, but they are by no means totally negative.

First, since process schizophrenics seem to be hesitant to initiate new activities, they could not be expected to show "spontaneous remission" as frequently as the reactives. This is a conclusion made after the fact, incidentally, since this is a well-established finding from other studies (19, 20, 123, 124). However, it does follow from the present data.

Of more interest is the implication that process schizophrenics would not be apt to be helped, but perhaps made worse by conventional psychotherapy. This follows from the fact that these patients are withdrawing from the external environment. Psychotherapy focused upon the patient's feelings and inner life would most probably tend to accentuate this non-adaptive behavior.

From the present findings, it would seem that the therapy of choice for process patients, whatever the duration of their psychosis, should be in the other direction. That is, envouragement to attend to and to manipulate the environment to an ever-increasing degree. Since they are prone to withdraw from frustration or threat, extreme caution would need to be exercised during the early stages. Manipulative tasks should be of a nature to provide many opportunities for success but a minimum amount of threat.

Interestingly enough, a few recent papers (74, 94, 115) report some success in just such a "reconditioning" program for "chronic schizophrenics".

Whether or not "shock therapy" could be expected to make the process patients sufficiently uncomfortable in their situation to drive them from self preoccupation is a debatable question. There is some face validity to the proposition. On the other hand, it could be held with equal logic that, since shock is imposed from without, it would lead to an even more profound distrust and rejection of the environment. Actuarial evidence is somewhat on the side of negative results for "chronic" patients. Since process patients have the poorer prognosis, it seems reasonable that a larger proportion of patients labeled "chronic" would also be classified as "process".

An interesting incidental conclusion can be drawn from the performance of the normal group under conditions that were relatively easy for them. The shape of their performance curve seems to furnish corroborative evidence for one of Hull's (56) postulates that has not been widely tested. Hull postulated that increments in habit strength can be considered as a constant fraction of gain yet to be attained. As the limit to which the skill which can be attained (ceiling) is approached, the increments in habit, according to Hull, become progressively smaller. Then, since temporary inhibition generated in a task seems to build up to a maximum and then to remain fairly constant, it would be approximately the same regardless of the stage of learning. Thus it follows that the relative decrement from temporary inhibition

ould be greater the closer performance is to the ceiling.
ince the normal 50 rpm group is considerably closer to the
eiling at the end of the first practice period than normals
t 60 rpm, it is understandable why the present normal-
assed learning curve flattens and dips at the end of the
irst practice period although this is not the case at 60 rpm.
n other words, this dip would support Hull's notion that
abit is negatively accelerated.

SUMMARY

The present study was concerned with performance of process and reactive schizophrenics on a rotary pursuit task.

A process schizophrenic is best described as having an early and insidious onset of psychosis with a relative absence of precipitating stress. Typically, he has had an inadequate prepsychotic personality. He shows a tendency to avoid interpersonal contacts and presents a clinical picture of flat affect and a relative absence of confusion.

A reactive schizophrenic, on the other hand, is one with a relatively abrupt and stormy onset of psychosis, usually attributable to a logical and significant stress situation. The prepsychotic personality has been normal or neurotic, rather than schizoid, with perhaps some degree of outgoingness. The clinical picture following the psychotic break is likely to include severe confusion and many affective components.

In the present investigation, Becker's modification of the Elgin Prognostic Scale was chosen as the device for selection of process and reactive subjects from the schizophrenic population of a neuropsychiatric hospital. All patients who met the criteria for the sample desired were rated on this scale. Their ratings were found to approximate a normal distribution. Subjects in the lower and upper tails of the distribution were classified as reactive and process

respectively.

The subjects so selected were tested on a pursuit rotor in order to obtain measurements of their adaptive behavior in a motor learning situation. Groups from each psychotic category were assigned to identical conditions of spacing and massing of practice while learning the task. Comparisons of the adaptive responses of process and reactive schizophrenics were then made.

Differences which showed a high degree of consistency throughout the testing were obtained. Statistical treatment of the data provided considerable assurance that these differences were not chance occurrences.

The chief findings with respect to process schizophrenics were: They took longer to adapt themselves and enter into the task. After a rest, they also took longer to regain their set and warm up in resuming practice. When these patients were continued under the same conditions for successive practice periods, they progressively improved in performance. When shifted from spaced practice conditions to the relatively more demanding massed conditions, however, their performance was markedly disrupted.

These results were interpreted as indications that process schizophrenics were hesitant in initiating new activities and prone to withdraw when thwarted. Supportive evidence for this interpretation was cited from studies of "chronic" schizophrenia and from the few reported studies

that have made use of the process-reactive concept.

Findings regarding reactive schizophrenia were largely in the opposite direction. They entered into the novel situation more quickly and took a shorter time to regain set after a rest. When continued under the relatively undemanding spaced conditions of practice, their performance deteriorated. On the other hand, performance continued to improve with successive periods of massed practice. When conditions of spacing and massing were shifted in either direction, the reactive patients showed an immediate improvement in performance suggestive of an elation effect.

These results were interpreted as evidence that reactive schizophrenics avoided their internal environments by a flight into activity. Then, when increasing skill rendered the task less effective as an escape device, satiation set in quickly. Any change in the task was therefore reacted to positively.

Supportive evidence for this interpretation was also cited from the literature.

Finally, some of the implications of these findings with respect to therapy and prognosis were pointed out.

As an incidental finding, supportive evidence was obtained for Hull's postulate that increments in habit strength may be considered as a constant fraction of the amount yet to be attained.

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APPENDIX

Scale of Apparent Psychosis

Subject_____ Ward ____

Date _____ Rater _____

I	I	I	I	I
No readily discernible evidence of psychotic thinking or behavior; non-psychotic thinking and behavior readily discernible		Evidence of psychotic thinking and behavior, and of non-psychotic thinking and behavior about equally divided		Evidence of little else but psychotic thinking and behavior; no readily discernible evidence of non-psychotic thinking and behavior.

Becker's Revision-Elgin Prognostic Scale

The definitions for the subscales of the Elgin Prognostic Scale and modified by the writer for use in this study are given below. Items A through O are rated on the basis of anamesis data. Items P through T are rated on the basis of the presenting clinical symptoms.

A. Defects of interest versus definite display of interest.

0. Keen ambitious interest in some of the following: home, family, friends, work, sports, arts, pets, gardening, social activities, music, dramatics.

2. Moderate degree in several activities including social gatherings, sports, music, opposite sex, etc.

4. Mild interest in a few things such as job, family, quiet social gatherings. The interest is barely sustaining.

6. Withdrawn and indifferent toward life interests of average individual. No deep interests of any sort.

B. Insidious versus acute onset.

0. Development over a period of 0-1 months with sudden, dramatic divorcement from more or less commonplace living.

1. Development over a period of 2-4 months with marked personality changes from relatively commonplace living.

2. Development over a period of 5-7 months with moderate personality changes. May be some accenting of previous trends, but changes also.

3. Changes have taken place over a period of 8-12 months with noticeable personality modifications, but primarily an accenting of existing trends.

4. Slow development of symptoms but possible to detect personality changes in the 2 years prior to onset.

6. Very slow development of symptoms so that the final disorder appears as an exaggeration of already strongly accentuated personality traits. Indications even prior to adolescence.

C. Shut-in-personality.

General: The psychotic condition is simply an exaggeration of the peculiar type of personality shown all through childhood. Stormy childhood often with over-protection and anxiety, a difficult adolescence characterized by inability to get along and mix with other children. Constitutional

apparently, rather than product of specific environment.

5. Very much as described above.

3. Moderately the picture described above.

1. Only mildly this way, but some resemblence to pattern.

0. Apparently normal childhood, little evidence of shyness, unusual difficulty or else unusual behavior is attributable to environmental factors.

D. Schizothymic versus syntonic personality.

0. Very sociable, fond of people and social gatherings; many friends, active in groups and sports, participates in life of his community.

2. Moderately sociable, likes people and social gatherings, but doesn't go far out of way to meet people.

3. Mildly shy, mildly sociable. Will interact when the situation presents itself. Prefers association in family group as a rule.

4. Moderately shy, retiring, etc. More concerned with ideas than people.

6. Very seclusive, shy, retiring, mixes little with others. Few if any close friends. Interested in ideas rather than people. Passive onlooker at life rather than an active participant. Poor "bite on life".

E. Range of interests.

0. Wide and varied interest, keen bite on life and its opportunities, forward and interested in making adaptation to daily life in many spheres.

2. Moderate breadth of interest, interested in making adaptations to daily life, but does not go out of way to seek new opportunities.

4. Moderate restriction of interests. Narrow goals, but some detectable variety of interests within a narrow orientation.

6. Inadequate interest in varied problems of life, rigid, narrow goals or interests, circumscribed activities because of the narrow range of interests.

F. Constitutional bias.

0. A healthy, strong energetic physical and mental makeup

that makes the interplay between heredity and environmental influence during childhood a satisfactory one.

2. Suggestions of defects in physical and mental stamina occasionally observed. Not at all marked. Perhaps proneness to repeated illnesses in childhood.

4. Regarded from early childhood as different, queer or odd; perhaps associated with some real defect or handicap-physical such as deformity, or speech defect, but more often only an imaginary defect of personality.

G. Low energy tone.

0. Very strong drive, keen active and alert interest and ambition shown in school, social and work spheres. Good grasp on life, liked life and had energy enough to enjoy it. Outgoing and adequate in meeting life.

2. Moderately adequate drive, interest, energy as described above.

4. Moderately inadequate energy tone. Tends toward submissive, passive reactions. Shows some potential to face life's problems, but would rather avoid them than expend the necessary energy.

6. Submissive, inadequate passive reactions, weak grasp on life, does not go out to meet life's problems, does not participate actively but passively, accepts his lot without having the energy to help himself.

H. Asthenic build.

0. Large, barrel-shaped trunk, with relatively short legs and arms; shield shaped face, short broad head upon a thick neck, set well down between shoulders.

2. Athletic build. Balanced weight, good musculature, head shape, etc.; intermediate to 0 and 4.

4. Long, slender extremities with relatively small, narrow trunk. Egg-shaped face; elongated narrow head on a tall, slender neck.

I. Heterosexual contact.

0. Purposefully contacts the other sex, dates frequently, makes successful effort to be attractive in manner, dress, accessories, etc. so as to be popular with girls (boys).

2. Dates when situation affords. Maybe marries, but has difficulties in compatibility. Wants to interact with other sex, has some techniques, but not completely successful.

3. If married, apt to divorce or separate. Generally this is rated as a midpoint between 2 and 4.

4. Moderate lack of heterosexual contact. Tends to avoid dates, dances, but has on occasion participated in same. Might think he (she) would like to marry some day, but little enthusiasm for it.

6. No association with the opposite sex. Never had any dates. Avoids dances and social gatherings which require the intermingling of boys and girls.

J. Marked academic interests versus active interest in sports.

0. An active interest in sports, participates in baseball, basketball, tennis, football, or other sports. A solitary sport such as swimming or golf is not so important unless the patient plays or swims with others rather than self.

1. Moderate interests in sports, and other interests.

2. Mild interest in sports, mild interest in study.

3. Moderate interest in study--without other interests.

4. Fond of study, worked diligently at school and excels in this field associated with inadequacy in sports and social field, a grind without the ambition or drive in work and play to equal his achievements as a student.

K. Careless indifference versus worrying, self-conscious type.

0. Subjectively sensitive, critical of self, preoccupied with own conflicts, but shows little of the extreme, bizarre, unusual, mysterious or socially unacceptable behavior.

2. Some concern and preoccupation with difficulties- a moderate position to 0 or 4.

4. Withdrawal and disinterest in social surroundings, careless of social requirements, given to day-dreaming and excentricity, dirty, disheveled appearance, profane language, unacceptable habits.

L. Exclusive stubborn traits versus insecurity and inferiority feelings.

0. Timid, lacks self confidence, feels insecure and inferior. Very sensitive and critical of self; feels certain problems in life but participates and does not accept his lot passively or without regret and struggle.

1. Moderately like 0.

2. Neither timid nor stubborn.

3. Moderately stubborn.

4. Complete withdrawal from surroundings and interest, inadequate in meeting life but stubborn and opinionated, refuses to change, even if suggested, to achieve a more adequate adjustment. Opinionated and egocentric.

M. Toxicity or exhaustion.

0. History of illness, disease or exhaustion closely associated with the onset of psychotic symptoms.

1. Illness present, not severe, but related to onset. Less severe exhaustion.

2. Poor health--but not requiring bed.

3. Fair health--a little run down.

4. Excellent health history. Health in no sense an etiologic factor in the development of psychosis.

N. Precipitating conditions. (Situational reaction)

0. A strong relationship between onset of symptoms and situational problems that would require definite and continued effort to adjust satisfactorily; i.e. death, failure, loss, interpersonal strife. The average person would definitely try to flee such a situation rather than attempt to change it.

1. Marked stresses related to onset, but not as severe as 0.

2. Moderate stresses related to onset such as financial problems, interpersonal discord, etc. which would cause considerable worry to the average individual.

3. Mild stresses that the average person would react to in some way but would not usually lead to a breakdown.

4. Onset of psychotic symptoms not related to any disturbance or difficulty in the patients situation- or a disturbance of such a trivial nature that it would be ignored or quickly forgotten by the average person.

O. Duration of psychosis.

0. Under 2 months
1. 2-4 months
2. 4-6 months
3. 6-8 months
4. 10-12 months.

5. 1-2 years
6. 2-3 years
7. Over 3 years

The following scales are rated from the presenting clinical picture.

P. Inadequate affect versus emotional instability of appropriate affect.

0. Adequate or overly demonstrative affective expression. This includes appropriate expression and manic depressive aspects in which there is a facile display of emotion.

2. Moderately inadequate affect. Tends to be rigid, dull, or slightly inappropriate. Only moderate responsiveness to emotional stimulation.

4. Markedly inadequate, inappropriate, rigid or dull affect. Emotional life expressed is at odds with behavior or strikingly inappropriate. Little reaction to stimulation of any strength.

Q. Hebephrenic symptoms; extreme indifference, complete divorce between ideas and affect; extreme carelessness in appearance and reaction with untidiness in some cases, silly behavior, often silly laughter without appropriate stimulation.

0. Not as above.
1. Mildly as above.
2. Moderately as above.
3. Markedly as above.
4. Very markedly as above.

R. Ideas of influence; patient feels that someone or something is directing his actions, thoughts, or speech. Some outside influence forces him to do things even against his own will.

0. Not as above.
1. Mildly as above.
2. Moderately as above.
3. Markedly as above.
4. Very markedly as above.

S. Physical interpretation delusions. The patient has certain feelings (possibly hallucinations) that are linked up with definite delusional ideas; for instance, that there is a snake in his stomach, that food passes right through his body, that someone is passing electrical currents through his body, that the food he eats is poisoned, etc.

0. Not as above.
1. Mildly as above.

2. Moderately as above.
3. Markedly as above.
4. Very markedly as above.

T. Atypical symptoms. Manic or depressive feature mixed with the schizophrenic picture. Display of appropriate affect, over-talkative, distractive, facetious, display of interest in other patients, desire to help humanity in general, depression, feelings of sin or guilt, psychomotor retardation, anxiety, crying.

0. Very markedly atypical picture, shows many of the above features with considerable strength of affect.

1. Markedly atypical picture.

2. Moderately atypical picture, less intensity of features shown.

3. Mildly atypical picture, unusual features are minimal or lacking in intensity.

4. Lacking atypical features.