PSYCHOMOTOR CONCOMITANTS OF PSYCHOLOGICAL DISORDER

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SUMMARY

A series of studies is reported in which a battery of psychomotor tasks was administered to psychiatric patients. The main emphasis was on the acute admission patient to determine whether such a battery can give reliable information in that context. A cross-section of diagnostic groups was tested on three occasions during treatment so that changes in clinical state could be related to test performance. Results were examined in relation to response to therapy, independently assessed by psychiatrists, and in relation to diagnosis.

The main body of results showed that the battery did provide meaningful measures sufficiently stable to show a close correlation with independent psychiatric judgement. Patients performed very differently from normal subjects but no specific diagnostic discriminators could be identified. What was apparent was that relative severity of illness was the most significant influence in determining levels of response. A scoring method was devised which showed that changes in performance were closely related to changes in mental state. Relationships between parts of the battery were discussed in terms of therapeutic intervention and the side-effects of drug therapy.

Results with simple reaction-time on an initial validation group of 44 patients were compared with a prospective group of 56 patients, showing closely similar findings. It was concluded that simple R.T. was most reliable with psychotic patients, was of less value with neurotics, and had nothing to offer in the assessment of alcoholics and psychopaths. Correlations between tests were found to be higher

among most patient groups than among normals, and the similarity with other work was demonstrated.

To demonstrate the areas of applicability, a number of case-studies were reported in which detailed information about patients could be seen reflected in test data. The value of the tests in a research assessment of drug therapy was also reported with particular emphasis on the influence of drug side-effects on test performance. It was concluded that a battery of tests can give information of several types relating to drug therapy.

The degree to which simple R.T. results can be accepted as reliable was investigated by using two independent criterion measures. The usefulness of simple R.T. was confirmed with psychotics (in this case depressives) by significant correlations especially with the more global measure of psychiatric disturbance - the Symptom-Sign Inventory. The confounding effects of E.C.T. were also identified.

The importance of the pre-preparatory interval in an irregular warning situation was discussed in relation to other work on schizophrenics. While the same variability of response was found, it was concluded that interpretations about its significance must be governed by the presence of a similar deficit among other functional psychotics. The similarity in responses of manics and depressives was of particular interest and may be of significance in the understanding of the relationship between mania and depression. An alternative model for the understanding of manic-depressive psychosis was proposed, on the basis of the results obtained here, together with information from a variety of other clinical and experimental work.

In addition to exploring the practical usefulness of psychomotor tests, a further study was concerned with a theoretical problem with schizophrenics. The performance of paranoid and non-paranoid schizophrenics, with and without drugs, on a choice reaction task was compared with a control group of normals. It was shown that while the absolute level of response was slower for the schizophrenics than for the normals, task-complexity did not produce any greater decrement among the schizophrenics. This finding was interpreted in relation to a theory of impaired data-processing among schizophrenics.

This thesis contains no material which has been accepted for the award of any degree or diploma in any University and to the best of my belief, contains no material previously published or written by another person, except where due reference is made in the text.

Signed

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A study of psychiatric patients stand or falls on the willingness of psychiatrists to make their patients available for study. Some fifteen have been good enough both to keep me in touch with patients in this way, and give their clinical opinions as requested.

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CHAPTER I

BACKGROUND OF THE STUDY

I. Previous clinical studies of psychomotor performance.

II. Aims of the present study.

III. Rationale for the test battery.

BACKGROUND OF THE STUDY.

I. Previous clinical studies of psychomotor performance.

The clinical usefulness of psychomotor tests in general is now beyond question. The earliest evidence dates back nearly a century to Obersteiner (1874) who showed psychotics to be slower than normals on simple reaction time. A number of other early workers confirm the point though their statistics and selection of groups could not stand up to current investigations. Bevan-Lewis (1899), for example, based his conclusions on means and standard deviations with only 5 subjects in the normal group and with from 5 to 24 in his diagnostic groups. Similarly, Scripture's (1916) groups consisted of 5 normals, 3 cases of alcoholism, 2 of hysteria, 3 of epilepsy and 2 of G.P.I. In neither study is consideration given to age or sex differences. At this early stage it was hypothesised that while psychotics in general would be slower than normals, manics would be faster. Klopsteg (1917) investigated a range of clinical groups and found that five undeteriorated schizophrenics were nearer to normal than any other psychotic group. Bevan-Lewis (1899) found that manics constituted the fastest subgroup of psychotics, but were still slower than normals. Only Scripture (1916) has claimed to find a group faster than normals, viz: whiskey-drinking alcoholics. He states "a comparison of the results of alcoholics with those of normal persons indicates some rather striking conclusions. It may be suggested that the drinking of malt liquors, like beer, produces a sluggish condition of mind that is very unfavourable to clearness of thought...On the other hand,

many records have shown that the whiskey drinkers respond with greater rapidity and precision than the normal person." Such a sweeping generalisation must be accepted with reservations since he quotes figures relating to only two beer drinkers and one whiskey drinker!

Lundholm (1922) also studied a group of manic-depressives and found that as patients went into states of excitement, both the mean reaction time and the standard deviation of the scores were increased. He concluded that they, in common with other psychotic groups, suffered a decrement of performance and states that "the instability of the performance in the psychotic subjects employed is to be considered primarily as a manifestation of an attentional disturbance."

His results largely confirm those of Franz (1906) who found "a decided slowing" on simple R.T. to sound. His study was commendable for the battery of tests used, for the careful reporting and detailed treatment of results as far as statistical knowledge half a century ago permitted. General conclusions are limited however by the number of subjects - 2 depressed, 2 "exhilarated", and 2 normals, one of whom was the author himself.

Wulfeck (1941) examined the performance of manic-depressives as well as other groups on several different types of psychomotor tests (Reaction co-ordination, Rhythmic patterns and star tracing) and observed that while they were faster than normals on reaction co-ordination, they were slower on star-tracing. He was of the opinion that their performance reflects the over and under-activity of such

patients - sometimes they exceed normal scores, while at other times they are significantly retarded.

The consensus of opinion, is then, that the average reaction time for all diagnostic groups is longer than that for normal individuals. A great volume of work has been carried out on the nature of the impairment in chronic schizophrenics without reference to other diagnostic groups.

An early careful contribution by Huston, Shakow and Riggs (1937) examined the performance of schizophrenics on auditory and visual R.T. and took account of relative levels of co-operation. They observed that even those patients rated as maximally co-operative were slower than normals. It was hypothesised that the schizophrenic is deficient in the ability to develop and maintain set, resulting not only in an overall poor mean level of reaction, but also in greater scatter of scores. When a discrimination situation was introduced, they also showed difficulty in shifting their set, and showed "a perseveration of expectancy." Later work (Rodnick and Shakow (1940) confirms the difficulty experienced by schizophrenics in developing and maintaining set. By comparing regular with irregular preparatory intervals, it was shown that schizophrenics do not benefit from the constant situation, but perform better when alerted by the uncertainty of the irregular P.I. This results in a cross-over phenomenon from which a Set Index has been derived and subsequently confirmed by Tizard and Venables (1956). These latter workers applied themselves to finding alternative explanations for their findings, postulating three alternative hypotheses, but rejecting them all in favour of the

original one. They state "our results also support the Worcester hypothesis that the defect is one of general attention, rather than due to inhibition or fatigue....."

Shakow and his associates have continued to explore the nature of the schizophrenic deficit with a battery of tests and a number of papers have reported their findings. Attention has continued to be devoted to the Set Index derived in 1940 and Shakow has said: "This index was able to differentiate the schizophrenic and normal subjects without overlap. This is the only instance we know of in which such a finding on psychological phenomena has been reported in the literature" (1963). Other studies have been concerned with the importance of the pre-preparatory interval (Zahn, Rosenthal and Shakow, 1963) and the degree to which improvement is possible when the patient functions autonomously rather than under pressure to respond (Cromwell, Rosenthal, Shakow and Zahn, 1961). The general finding is that under pressure to respond the schizophrenic performs badly but is able to function more efficiently when self-paced.

Most recently, Zahn and Rosenthal (1965) have examined the value of the Set Index in relation to acute schizophrenia. While able to demonstrate a statistical differentiation from non-schizophrenics, the degree of overlap produces a note of caution about its diagnostic value. The fact that the response levels reported were so close to normal was associated with the fact that a number of their subjects were already "in partial or complete remission at the time of testing," so the most convincing conclusion is that relative levels of performance are a function of severity of illness.

The importance of motivation as a variable has been explored by Rosenbaum et al (1957). Two papers examine a number of hypotheses relating to biological and social motivation as well as the effects of age. The first paper makes it clear that conflicting results were derived, some patients sustaining the hypothesis, others doing the reverse, simply underlining yet again the futility of adopting the diagnostic label as a unitary concept. The second paper, by correlating together a number of variables purports to identify three significant factors influencing speed of reaction, viz. biological hyporeactivity, reduced social responsiveness, and uncontrolled anxiety.

The effect of the interpersonal relationship as a motivating variable in chronic schizophrenics has been reported by Berkowitz (1964). He found that following warm and friendly contact schizophrenics' performance was poorer than if a more aloof contact was made or no contact at all prior to testing, when after training, there was no significant difference between the normal and schizophrenic groups using simple R.T. Berkowitz concludes: "chronic schizophrenics can be motivated to gain approval but such motivation in schizophrenics is more dependent upon immediate social circumstances than it is in normal adults."

A more convincing replication of Rosenbaum's study has now been reported (1967) in which social motivation and anxiety motivation left the schizophrenic groups significantly impaired relative to a normal control group, while shock motivation greatly improved

schizophrenic performance to a point not far removed from a normal level. These findings are consistent with those reported by Berkowitz (1964).

The question of a motivational deficit has been more carefully explored by King (1954) who proposes several arguments from his data to discount its importance, at least as the only explanation for observed deficit. Later Stotsky (1957) again looked at the possibility of motivation as the problem, but he too, using King's battery of tests remained unconvinced. He found that reinforcement was able to achieve a greater improvement than with normals on the simple tasks but with increasing complexity no further gains could be achieved. He concluded "impairment of psychomotor functions among schizophrenics is not explainable in terms of a single general factor such as motivational deficiency or constitutional maladaptation."

There has been less use of psychomotor tests in the exploration of brain-damaged subjects. Indeed no direct reference to such studies is included in Yates' (1960) review. Such investigations would of course be of little value without some clear identification of the nature of the damage in groups studied and more often than not such information is difficult to obtain from reading the papers.

Exceptions include several studies by King. His initial contributions in this field formed part of the study of the effects of topectomy carried out by the Greystone-Columbia Associates. Pre and post-operative assessments showed that while transitory effects of the order of 15 percent could be measured (1950), there was no

permanent effect for better or worse on a wide variety of functions including psychomotor ones (King and Clausen, 1956). Subsequently he has reported (1961) enhanced psychomotor performance in chronically sick patients undergoing electrical stimulation of the limbic system as a form of therapy. Tentatively, findings have also been reported with cases of neoplasm, C.V.A., epilepsy, temporal lobe spiking and Parkinson's disease (King 1962). As with other work the general conclusion is that psychomotor efficiency mirrors the degree of dysfunction at a cortical level. A linear relationship "suggests that adequacy of simple psychomotor function may serve as an effective index of total organism responsive integrity over a wide range of C.N.S. disorders."

Similar conclusions concerning the poor performance of patients with cerebral disease have been drawn by Blackburn and Benton (1955) and Costa (1962) but with less careful attention to the precise location of the damage. Benton et al (1962) have since looked more closely at the problem and shown that subjects identified as suffering from diffuse brain damage (but not those with focal damage) have a particular difficulty with cross-modal reaction time task where a visual stimulus was preceded by an auditory stimulu (but not vice versa). Interestingly this is in contrast to their findings with schizophrenics who demonstrated difficulty when reacting to auditory stimuli preceded by visual stimuli, but no explanatory hypothesis has been advanced.

A study reported by Knehr and Brown (1957) used a Series Choice Reaction Time situation in order to assess perseveration among brain-damaged, schizophrenic and normal subjects. No distinction was achieved between the latter two groups whereas the brain damaged group performed significantly badly, and the procedure is claimed as a useful diagnostic tool, using an appropriate cut-off score "yet to be more precisely determined." Since such a finding is contrary to other work, where such a neat difference has repeatedly failed to appear, and since the absence of a schizophrenic deficit is also as they admit "in marked contrast with previous studies" the findings must be called in question. In particular one notes that in spite of repeated evidence in the literature that the severity of illness is a crucial determiner of psychomotor efficiency, the groups compared were clearly different in this respect. Of the 15 organic patients, 13 were hospitalised, whereas of the 15 schizophrenic patients only 3 were in-patients. It is therefore doubtful whether they have done more than show again that severity of illness is reflected in psychomotor function. In summary, these papers deal with work where the diagnosis remains fixed and the test situation is varied, e.g. in terms of complexity or motivation.

Another approach has been to adopt a specified psychomotor procedure and apply it to a variety of diagnostic groups in order to discover possible differences between groups. Subjects have been defined in terms of conventional psychiatric categories. Bevan-Lewis (1899) and Scripture (1916) were trend-setters in this approach. Much significant work has since been reported (e.g. Huston and Senf, 1952,

King 1954, Hall and Stride 1954, Knehr and Brown , 1957, King, 1962, Dillon 1961).

A slightly different approach has been to rely not on diagnosis but on symptomatic manifestations. Something of the need to get away from the psychologically unsatisfactory categories in use in psychiatry was seen by Lundholm (1922) who although primarily concerned with manic-depressive psychosis, was led through a consideration of his data to conclude "Readings from patients in agitated states always gave broad and low frequency curves independent of the underlying mood." In other words he found it more meaningful to focus on the symptom of agitation rather than the mood-swing. Other specific manifestations which have been related to reaction time performance include anxiety (Wenar 1954), (Castaneda 1956), motivation (Stotsky 1957) hypertension (King 1956) and perseveration (Knehr and Brown 1957).

Lewinson (1940), too, in discussing handwriting changes among manic-depressives, shows a preference for a symptomatic breakdown of elated manic, irritated manic, apathetic depressed and agitated depressed.

The present approach is something of an "umbrella" one. Records were obtained on as many patients as possible irrespective of diagnosis, in order to determine what the areas of usefulness may be. It is, after all, inadequate to refer to a psychomotor deficit in schizophrenics when compared with normals, if the other diagnoses also demonstrate the same deficit.

As Mulfeck (1941) has observed "it is not enough to compare one group of patient of like symptoms with a normal control group. To be sure, a normal control group is necessary as a point of reference but the problem of differentiating between the various types of mental disease can best be met by a direct comparison of the several types with one another."

The other main emphasis in this study is on what happens to psychomotor performance during the course of treatment. Most experimental work has been concerned with a single sample of behaviour, but there has been evidence accumulating to show that psychomotor measures are stable enough to justify interpretations through time. King (1950) followed patients receiving surgery to the orbito-frontal cortex and showed a significant decrement ten days after operation which he attributed to a "temporary interference with a motor integrative system at the higher levels."

Brower and Oppenheim (1951) demonstrated changes following E.C.T. by using a battery of tests, finding patients "less able to control motor discharge" after treatment.

Hall and Stride (1954), as an aside to their main study of auditory reaction time with patients, retested 6 patients several times (4 depressions and 2 schizophrenics) and related performance to a psychiatric estimate of clinical state. They conclude "variability measures of response to stimulus sequences, such as were used in the present study, may be valuable as objective indicators of improving response efficiency and awareness resulting from treatment."

Brooks and Weaver (1962) and Weaver and Brooks (1964,1967) report re-test results with chronic patients involved in a re-habilitation programme. They too found that psychiatric status was a "potent determiner of psychomotor performance level," and by allowing sufficient time-lapse, far exceeded any effects due to practice.

Psychomotor tasks are most commonly taken to refer to such tasks as reaction time, peg-board, tapping and track-tracing. But in that psychomotor testing is concerned with the precise co-ordination of a sensory process with a motor activity, handwriting also constitutes a legitimate area of psychomotor enquiry. The study of handwriting lost respectability as a result of attempts to use it too widely and make sweeping conclusions from subjective interpretations. Nonetheless a residue of scientific inference has been retained so that once again studies of handwriting are being found useful.

Allport and Vernon (1933), using careful statistical procedures, examined several hundred measures relative to speed, size of script and pressure of movement, and concluded that a considerable degree of uniformity appears in a repetitive performance.

It follows that if one can assume that handwriting is usually consistent in speed, size and pressure, then changes in these parameters may be related to mood-swings or treatment.

The influence of mood on handwriting is well demonstrated by Roman (1961) both by interpretative comments and many examples. There is a general correlation between constricted handwriting and depression on the one hand and expansive writing and elevation of mood on the other. So for example, "a big showy hand goes with a need for exhibiting oneself, thereby to impress the world and to win public recognition." Or again "letters spaced generously in the writing field...characterise generous, outgoing personalities. Excessive width is symptomatic of lavishness and extravagance."

Conversely "downward tending lines may be regarded as symptomatic of a depressive state in the clinical sense, when found in association with small-sized letters, low pressure, slack connective strokes, leftward tending arrangements of the whole pattern, and a signature placed in the lower lefthand portion of the page." And again, "small, lax handwriting,....may be connected with a disintggration of personality and depressive moods."

Lewinson (1940) distinguishes between the elated and irritated phases of manic excitement, and between the apathetic and the agitated depression. She follows Heinen (1928) in relating manic states with hyperkinesis, apathetic depressions with hypokinesis, and agitated depressions with dyskinesis. Relating these to handwriting she asserts "hyperkinesis is expressed in increased movement, pronounced size, speed and occasional pressure. Hypokinesis is expressed in decreased movement, smallness and lack of strength. Dyskinesis means that the writing is characterised by restlessness of movement and lack of adequate strength."

Current psychiatric practice, unfortunately, complicates any simple measure of handwriting taken as a guide to mood-state. Many of the psychotropic drugs in use have recognised side-effects associated with extra-pyramidal system functioning. Haase (1955, 1964) and his co-workers have investigated the effect of phenothiazines on handwriting, asserting that the therapeutic effectiveness of these drugs may be measured by changes in handwriting, i.e. the more pronounced the side-effects, the more beneficial the drug. This argument is not proven, but the appearance of micrographia is undoubted.

There is strong evidence indicating that some drugs do depress psychomotor performance generally, but the association is not a straight-forward one. Legge and Steinberg (1962) showed that Amphetamine improves the performance of normals, while cyclobarbitone markedly depresses it. Benjamin, Ikai and Clare (1957), also using normal subjects, found a decrement in psychomotor performance under prochlorperazine ("Stemetil"). The effect of alcohol is, according to Teichner (1953) to increase variability and length of R.T. Pearl (1962) compared the effects of four phenothiazines on Purdue pegboard and R.T. performance, and found a significant decrement on the assembly part of the former, and no significant differences on the latter. Chlorpromazine was found by Heilizer (1959) to have a selective effect on behaviour in chronic schizophrenics, with greater consistency on a psychomotor task when compared with a control group. Kornetsky and Humphries (1958) found that chronic administration of chlorpromazine ("Largactil") to schizophrenics produced no detectable impairment of R.T. Performance.

It is, of course, important to distinguish not only between stimulants and sedatives, but also between administration to normal subjects (where one could expect sedatives to produce a reduction in efficiency) and to the mentally ill (where one might expect a sedative to improve performance). The importance of such diametrically opposite effects in relation to personality variables has recently been underlined by the work of Munkelt (1965) and given prominence by Eysenck (1966).

Huston and Pinger (1945) compared the performance of chronic schizophrenics and normals on a reaction time task using regular and irregular preparatory intervals, both without drugs and following injection of sodium amytal and amphetamine. They reported that normals performed more slowly on medication, while the schizophrenics proved better able to maintain an appropriate set so that speed of reaction to regular P.I.'s was increased. Zahn and Rosenthal (1965) found acute patients on drugs slightly, but not significantly better on reaction time than non-drug patients.

In 1952, Huston and Senf extended their study to include other psychiatric groups and found improvement with depressed patients with comparable administrations of sodium amytal and amphetamine.

Pishkin (1962) reports a significant improvement in the performance of regressed, depressed schizophrenics in response to Nialamide ("Niamid"), but not with Imipramine ("Tofranil").

The present situation has been summed up by King (1961)

who states:

> "A body of evidence, classical and recent, does suggest that measures of some of the simplest psychomotor functions may serve as an index of what might be called total organism integrity or effectiveness.....It would appear, from these lines of evidence that a change in psychiatric or physiologic variable strong enough to produce detectable clinical changes in behaviour will also bring about measurable and systematic changes, in the adequacy of simple psychomotor function."

His most recent assessment of the situation endorses the work reported here in recognising both the wide range of suitability of psychomotor measures and their close correlation with severity -

> "Whenever the balance of total organismic factors is affected by persistent strong emotion, marked physiologic imbalance or structural damage to the central nervous system....the psychomotor adequacy of the individual may be shown to be affected proportionately." (King 1968).

The way forward is pointed by Brooks and Weaver (1962) who, in summarising their own work, say:

> "These techniques need very much to be validated in use.... They appear to work well for the chronic schizophrenic group. It is entirely possible that they will work to some extent for other diagnostic groups or perhaps for mental disorders as a general class. But, at our present state of knowledge we are justified only in saying that these techniques appear to be applicable to the class of chronic schizophrenics."

This survey of the literature indicates that the study of psychomotor activity has now gone through phases which seem to be the common lot of most measuring techniques, as well as many therapeutic devices. First, an early exploratory period, when a number of general parameters were established against a background of poorly-planned research, and sweeping conclusions were based on insufficient evidence. Following this there was a period of enthusiastic application of techniques to a host of situations, motivated by the belief

that here at last was the technique par excellence for every occasion. Soon it was realised, however, that psychomotor measures, while useful, do not provide the ultimate in psychological testing, since there are many variables to be accounted for in the interpretation of any findings. A third phase therefore consisted of a minute appraisal of the most detailed features of experimental situations which might be relevant in interpreting findings. The pioneer was thus succeeded by the enthusiast, who was in turn followed by the careful experimentalist. Psychomotor testing is in part still at this third stage, though more recently a fourth phase has been reached, viz. that in which it becomes possible to apply the results of rigorous experiment in a practical context.

Although there is now an extensive literature on psychomotor functioning, remarkably few longitudinal studies have been reported. King (1968) has remarked that "the use of simple psychomotor tests to follow change-in-status by a given patient, or group of patients, over time, is still comparatively rare." Most papers give accounts of academic investigations into psychomotor functions. With a few exceptions, such as the work of Rodnick and Shakow (1940) and King (1954) developments in the clinical application of psychomotor procedures have been confined to the last five or six years. Even to the present time, reports relate almost exclusively to studies of chronic patients. Although the chronic psychiatric population is numerically significant, psychiatric attention is increasingly being devoted to the management of acute illness. It is therefore time that psychological techniques paralleled this changed emphasis.

Among the reasons for the changed emphasis is that the past ten years have seen greatly increased development of drugs for use in psychiatric states. Nonetheless an acceptable scientific evaluation of the effectiveness of these drugs is far from easy. The trend has been to depend on subjective assessments. Consequently the relative efficacy of drugs tends to be measured qualitatively rather than quantitatively, and when in doubt the clinician's judgment has been the final arbiter.

Such a state of affairs is far from satisfactory. In the determination of which drugs are effective, under which conditions, to whom, when and in what dosages, the psychologist should surely be able to play an indispensable part. In treating the acute patient especially, the psychiatrist wishes to know at an early stage whether a chosen regime will prove effective so that he may continue with it or change it. The most recent trend is therefore to apply more rigorous criteria to the clinical situation. The last few years have seen increased interest in methods designed to offset the clinician's subjective impressions about his own work. Rating-scales and questionnaires are currently being validated in research situations. In particular, the Hamilton Rating Scale for Depression, first introduced as an experimental tool (Hamilton 1960) has given rise to a number of studies on depressed patients (e.g. Schwab et al 1967) and has more recently (Hamilton 1967) itself undergone a fuller evaluation.

Similarly, wide interest has been shown in the scales developed by Foulds (1965) in his theoretical reorganisation of the phenomena of what he prefers to call "personal illness." He draws the important distinction between personality variables and symptom variables. The former remain relatively unchanged during illness and the Hysteroid-Obsessoid Questionnaire has been devised to measure these. The latter change as a function of illness and such changes may be identified using the Symptom-Sign Inventory.

The Symptom-Sign Inventory (S.S.I.) has attractions when studying a heterogeneous group of patients in that the scales are structured to cover all degrees of illness and do not require one necessarily to accept all the author's theoretical propositions. One may use the S.S.I. and still communicate with colleagues unfamiliar with Foulds' work using tests from another theoretical background (McAllister 1968). The S.S.I. has been used in only one of the present studies because it was not available at the time the initial collection of data was planned.

The techniques referred to are still in the early stages of development, and depend on verbal judgements, so a strong case can be made for examining the value of behavioural measures. They are also better suited than verbal methods to the evaluation of the acutely ill patient. Moreover, similar problems of evaluation are repeatedly being encountered with chronic patients; with many regressed patients there is a severe limit to the psychological tests one can administer,

and it is thus difficult or impossible to detect small changes of condition. Yet even marginal improvements are worth detecting if a means can be found to do so. An impressive demonstration of the usefulness of a psychomotor approach for this purpose is contained in the work of Brooks and Weaver (1962), who developed a battery of tests to assess which chronic patients would benefit from a rehabilitation programme. (See also Weaver and Brooks 1967). In the light of their work, they state:

> "A general way of looking at mental disorders, or perhaps schizophrenia in particular, would consist of hypothesising a basic reduction in the efficiency of information processing somewhere in the C.N.S. and that perhaps the general class of psychomotor tests are a method of measuring this reduction in efficiency.....Further studies are required to clarify the question of whether these defects in the transmission of information have different patterns for different mental disorders and what type of psychomotor tests prove most efficient for measuring the defect in each class of disability."
>
> "If psychomotor performance presents, as it seems to, an adequate measure of the efficiency of communication within the C.N.S., and if the unitary concept of mental illness has some validity, adequate measurement of psychomotor performance should prove invaluable not only in estimating the degree of maladaptation in individuals but the success of any one of a variety of treatment methods whatever may be the source of impeding the flow through the C.N.S."

II. Aims of the Present Study

This study reports the application of a battery of psychomotor tests to acute psychiatric patients. Their suitability has not previously been demonstrated in such a context. The problems are in some ways the same as those encountered with a chronic population, but there are probably more variables to be accounted for in a population of acute patients: for example, length of illness prior to admission,

medication before admission, and the complications of attitude and motivation for the patients newly-settling into a hospital setting. Thus, it might reasonably be supposed that, while stable and meaningful data could be derived from a long-stay population, the variety of influences surrounding the acute patient would make for unreliability of test results from such a group.

No previous work has been reported in which a substantial group of acute patients of varying diagnoses has been followed longitudinally. The plan of the study was to take first a heterogeneous group of acute psychiatric patients and obtain psychomotor measures during their treatment. The initial results with a group of 44 patients when compared with a sample of normals were sufficiently promising to lead to a follow-up study. Criteria of assessment obtained in the first study were applied prospectively to a further 56 patients and another group of normal subjects and confirmed the value of psychomotor testing in longitudinal assessment of psychiatric illness.

This led to the posing of a number of specific questions, answers to which were sought in a series of intensive investigations:

A. For this technique to be of clinical value it needs to be sensitive in the individual case as well as showing group differences. A number of individuals were therefore followed through in more detail and quite small differences in psychiatric condition were found to be sensitively reflected in psychomotor performance.

B. Psychomotor tests could be particularly valuable as independent objective criteria of response to drug therapy, so a study of changes concomitant on the administration of "Haloperidol" was carried out and proved to distinguish between central and peripheral effects.

C. By analysing the reaction-time task into its separate components, and extending its complexity, it was applied to the problem of the nature of schizophrenic deficit. The speed with which both paranoid and non-paranoid patients handled increasingly complex input was compared with a matched normal group. It was possible to show that although the patients were slower at all points, the rate of deterioration with increased complexity was no different from that found with normals.

D. Because the initial study was carried out in circumstances in which good external criteria were not available, the reliability of simple R.T. as a measure of severity of illness was tested with a group of psychotically-depressed patients, who were also assessed on two other measures of depression. Simple R.T. was found to provide a satisfactory index of severity of illness.

E. Arising from the observation in each study that levels of performance relate to severity of illness, the data obtained from manic depressives was re-evaluated in the light of current thinking about this disorder. The finding that hypomanic patients perform as a group worse than depressives raised the

question whether they are more severely ill rather than ill in a different way. A reformulation of the traditional view of manic-depressive psychosis was considered and found consistent with work from other fields.

III. Rationale for the Test Battery.

No suggestion is made that the battery of tests represents a complete cross-section of possible psychomotor tests. The criteria of selection were

(1) that they should assess efficiency of performance in terms of speed and accuracy but at as simple a level as possible, so that even the most disturbed or most limited patient would be able to achieve something

(2) that they should have been demonstrated to be useful clinically

(3) that it should be possible to score and administer them easily, rapidly and objectively.

The essence of these criteria was that a clinically-useful battery should be developed, rather than one which would answer fundamental questions about the functions involved. Hence, patients were asked to respond only 20 times on each occasion to an irregularly-presented light stimulus, taking rather less than five minutes. A clear contrast is found in the valuable experimental work of Rodnick and Shakow (1940), whose test procedure involved 132 responses, taking almost an hour to complete. While their results are of theoretical significance, there is a real need for

a procedure which can be applied routinely.

Attention was paid in the development of the battery to the likely emotional impact of the test battery. Tests were to be administered on three occasions, the first of these being very shortly after admission to hospital. Since admission is of itself often disturbing, the battery was made as non-threatening as possible. From well over 100 patients seen, only one refused to co-operate and only two or three proved unable to complete the battery by virtue of their disturbed state. It is clear that this battery conforms to the requirement of being simple enough.

A psychomotor battery does appear to be sufficiently stable and yet sensitive, for the psychologist to be able to answer a number of the psychiatrist's questions like, "Is this patient getting any better (or worse)?", and, "Is drug A more potent than drug B?", or even at the symptomatic level, "Is this patient less retarded than he was?", or "Are the side-effects of Drug C being reduced by the administration of Drug D?".

Chapter 2.

STUDY OF 100 ACUTE PSYCHIATRIC PATIENTS.

I. Composition of the Test Battery

II. Apparatus

III. Rationale of the Test Procedure

IV. Details of Administration

V. Nature of the Sample

VI. Clinical Correlates.

CHAPTER 2.

STUDY OF 100 ACUTE PSYCHIATRIC PATIENTS.

I. Composition of the Test Battery

The battery of tests was selected from a wide range of possibilities according to the clinical criteria already outlined. Since the object of this study was to develop a clinically useful technique it was decided to emphasise measures for which adequate knowledge of parameters of performance was available.

The battery was in three parts:

(i) handwriting
(ii) peg-board
(iii) simple R.T.

Handwriting was selected as an introductory procedure because it was a task almost everyone could attempt. Writing one's signature constituted the first part of this, forming an introduction which would not be refused. Copying 'United States of America' was then required; this was chosen because of its use by Babcock and Levy (1940) and Shapiro and Nelson (1955), as an error-free test, though in this instance the measure taken was of size, not speed.

A series of OXOX's followed in order to provide a speeded writing test. The final writing task was to produce continuous loops over a distance of at least two inches. The object of this part of the battery was to provide samples of behaviour from which measures could be derived of speed and size reflecting such things as mood, efficiency and side-effects.

Peg-boards in one form or another have been widely used in clinical and vocational psychology. The Purdue peg-board (Tiffin and Asher, 1948) has the most normative data, and many studies (e.g. King 1954, Weaver and Brooks, 1961, Pearl 1962, Brooks and Weaver 1962, Costa, Vaughan, Levita and Farber 1963) have included it. The board used in this study was first used by Hetherington (1956) and proved adequate in providing a measure of dexterity of movement, comparable to the transport score on the Purdue peg-board. Simple R.T. has been extensively used from the days of Obersteiner (1874) to the present as a basic psychomotor task.

II. Apparatus

For the writing tests a record form was placed in front of the patient. This had 'United States of America' and 'OXOX' already printed, to avoid spelling errors in the case of the former and to aid explanation of the latter. Writing was usually carried out with a pencil, but if a patient insisted on using his own pen or ball-pen on the first occasion, this was adhered to on subsequent occasions, to avoid distortions of relative speed and size.

The peg-board contained 63 pegs in nine rows of seven (see Fig. 2.1).

The simple R.T. apparatus was constructed in the psychological laboratory (see Fig. 2.1). The stimulus was a light (diameter 0.5 ins., 1.6W). Responses were made by releasing a spring-loaded button at the appearance of the light. The response key was pressed down in preparation at a verbal signal of "Press down now," at which time the delay-box was also activated. The delay-box made it possible to select

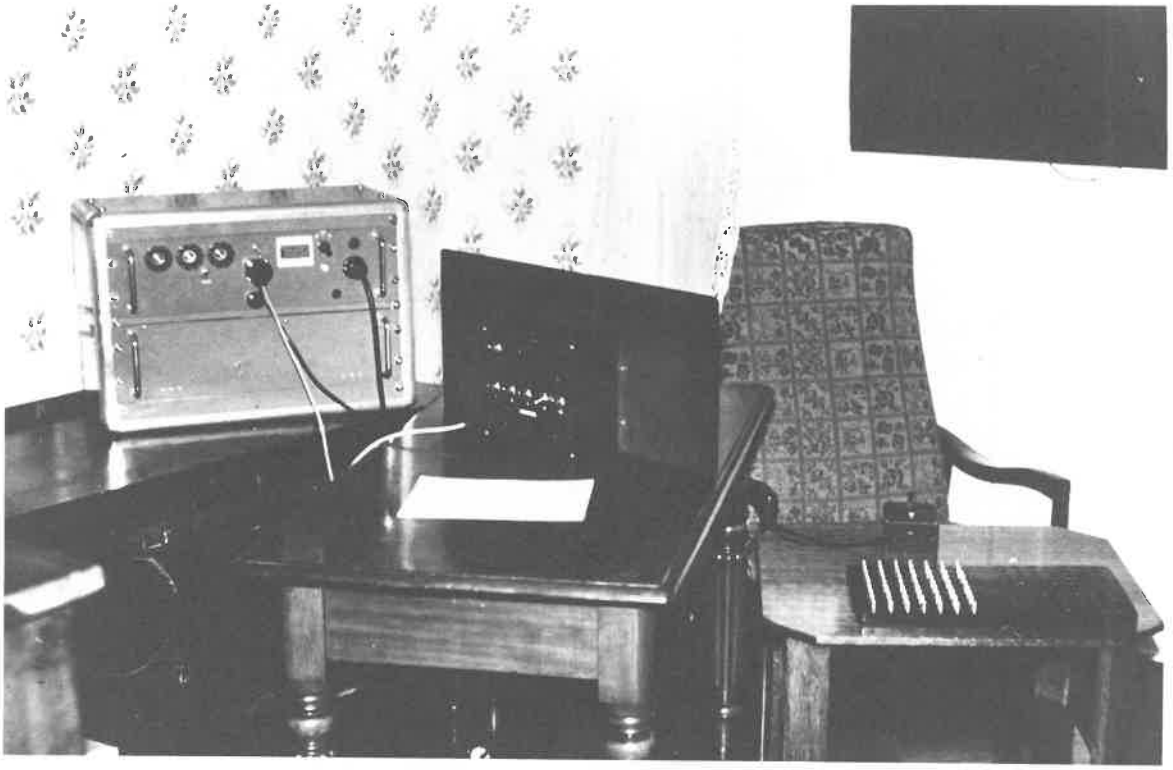


Fig. 2.1 - Apparatus for the psychomotor battery

manually preparatory intervals (P.I.'s) of 1, 2, 4, 8 or 16 secs. The intervals were selected in an irregular sequence which remained the same on each occasion. (See Table 2.1).

1. 4	6. 4	11. 2	16. 8
2. 8	7. 2	12. 8	17. 4
3. 2	8. 16	13. 16	18. 16
4.16	9. 8	14. 4	19. 2
5. 1	10. 1	15. 1	20. 1

Table 2.1 - Irregular sequence of P.I.'s used on every occasion.

The range of P.I.'s chosen was adopted in the light of Rodnick and Shakow's (1940) work, with the slight difference that 8 and 16 second P.I.'s replaced their 7.5 and 15 second P.I.'s.

The irregular sequence was arranged to ensure that the same did not recur twice successively and with special attention to short P.I.'s to ensure that 1 and 2 second P.I.'s were preceded by all the other P.I.'s Klemmer (1957) had emphasised in general terms the importance of expectancies in relation to length of P.I. - "Simple R.T. varies with subject's uncertainty about time of stimulus occurence...Foreperiod variability adds uncertainty directly and mean foreperiod is important since a S's ability to predict time of stimulus occurence is very much a function of the length of time he must predict."

It also seemed worth exploring the importance of the pre-preparatory interval in psychiatric disturbance. It was with the intention of

detecting the influence of long and short P.P.I.'s that the above stimulus sequence was planned. On the basis of some pilot runs, it was hypothesised that long P.P.I.'s would result in greater variability of response among patients than among normals. Since this study was started, a report has been published by Zahn, Rosenthal and Shakow (1963) showing this greater variability, and emphasising its importance in the development of an appropriate set.

Speed of reaction was measured with Dekatron counters to the nearest .01 secs. Technical details of the entire circuitry are to be found in Appendix II.

While the peg-board provided a measure of speed on a continuous task, the simple R.T. was included to assess the speed of initiating a response. Although for the purpose of understanding the fundamental processes responsible for fast or slow psychomotor performance it is of value to use a variety of R.T. procedures (e.g. choice R.T., disjunctive R.T.) as has been done by King (1954) and others since, the simple lift R.T. was chosen for this battery because it is the most straightforward.

III. Rationale of the Test Procedure

The battery of tests was administered to each subject on at least three occasions in order to obtain a longitudinal view of changes in performance.

Patients were tested shortly after admission, during treatment and wherever possible, towards the end of treatment. Any attempt to adhere to a rigid schedule of times would have foundered on the unpredictabilities of everyday clinical experience, and, although a general pattern was adhered to, considerable flexibility was also indulged to meet the individual case.

The usual pattern of events was to administer the battery the day following admission, again after approximately three weeks, and then again three weeks later. The time-scale was derived on the clinical assumption that most patients achieve the largest part of their recovery within six weeks, and to conform to the need to spread testing sessions as widely as possible to minimise practice effects, (Breitweiser 1911). The day of admission was avoided, since the possible trauma of hospitalisation might easily have made performances artificially poor. Although one might have wished to extend the settling-in period, clinical pressures to initiate treatment dictated that the usual policy should be to test soon after admission.

While the intervals of three weeks were largely adhered to, there were occasions when recovery was taking place very rapidly (especially with manic-depressives), so it became necessary to test again as soon as a week after admission in order to gain an assessment of the transition to health. Similarly, when patients were to be discharged before six weeks had elapsed, the last occasion of testing was brought forward whenever possible.

An extension of the planned time schedule also occurred with patients who improved only slowly or not at all, if testing at the appropriate time would have only confounded the picture. Delays of this sort were introduced, for example, to avoid testing patients immediately after electrical treatment.

On the basis of this rather fluid procedure, it became possible to hypothesise that patients would perform badly on the first occasion, and progressively better on each ensuing occasion if they were responding to treatment. If, in the intervals between testing, there was no clinical improvement, it was hypothesised that their performance would remain unchanged or improve but slightly.

In order to assess the amount of improvement in performance which could be expected due to practice, a group of normal subjects was tested in the same way as the patients. For this control group it was possible to keep rigidly to intervals of three weeks between test sessions. It happened that 12 of the group were student nurses, newly-arrived into the nursing-school; thus a fair match for the initial impact of hospital admission on patients was simulated in the control group.

IV. Details of Test Administration.

Patients were seated comfortably in an arm-chair in order to depart as far as possible from a 'test atmosphere' and ensure that they felt relaxed and unthreatened. After a period of conversation, the battery was introduced with the explanation that its purpose was to help ensure that they got the best treatment possible. It was

indicated that, by means of these tests, it was possible to judge whether they were getting better and, if so, how much; in this way the doctor was able to provide the most suitable treatment and discharge would be brought about as soon as possible. In these terms they were encouraged to do as well as they could. A low coffee-table was placed in a comfortable position in front of subjects.

Writing tasks were completed first, starting with the signature. No assessment was made of this later; its purpose was simply to allay any possible fears or suspicions concerning the nature of the tests. "United States of America" was then written in long hand. This was typed alongside to avoid spelling errors. Instructions were then given for the OXOX task: "I want you to write OXOX as fast as you can for fifteen seconds. Write in capitals as you see on the paper in front of you. Start as soon as you like and write as fast as you can - I'll tell you when to stop."

The final piece of writing involved producing continuous loops. The instructions were as follows: - "Finally I want you to write a series of loops to look like 'e's all joined up together. There is no timing for this - just write comfortably. I will tell you when to stop." To make the nature of the task clear, a small card was shown with loops on, but this was withdrawn before writing was started, so that there would be no attempt to match for size what had been shown.

Paper and pencil were then replaced by the pegboard, which was placed so that the pegs were to the left and the empty half of the board to the right. Subjects were shown that the pegs moved freely

in and out and told that they would be asked to move them in three ways: first, with the right hand across to the right hand side, then back with the left and, finally, back to the right again using both hands. They then practised by moving the top row across with the right hand and back with the left. Last instructions were, "Now I want you to be as fast as you can. Remember to use your right hand only and move one peg at a time. Steady the board with the other hand if you wish."

The simple reaction-time situation was kept until last, to allow the maximum time for settling and so that it followed a series of tasks which it had been possible to deal with without stress. It was assumed that this test would be the most sensitive to any sort of distraction, so the earlier part of the battery provided a standard preparation for it. The subject was encouraged to press the button to become accustomed to the pressure needed to keep it depressed. A series of introductory responses was then tried to ensure that everything was understood. They were told that they would need to respond twenty times to the light, each time as quickly as possible. "Sometimes the light will appear after a very short time, sometimes after what seems a long wait. These will be all mixed up, so you will not know whether it is going to appear at once or later. Be prepared, so you don't get caught unawares and let go just as quickly as you possibly can."

At the end of the test session, it was explained to subjects that they would be asked to do the tests again after a period, but no indication was given as to whether their performance had been good or bad.

V. Nature of the Sample

Data were collected in two phases; the first phase involved testing a group of 44 patients together with a group of 34 normal subjects derived from the staff of the hospital. On the basis of these results mean values for the groups were established, and for the purpose of statistical procedures, transformed R.T. scores were obtained so that their distribution would approximate to normal. Furthermore, a comparison was made at this stage between R.T. changes and the psychiatric opinion of change in mental state. Having achieved criteria of maximum agreement between R.T. changes and psychiatric opinion, a further 56 patients were tested in the second phase as a cross-validation group to find whether the criteria originally adopted would be confirmed.

Because of this procedure, it is possible to consider the R.T. performance of eadh of these groups separately and then together, though peg-board and handwriting will be considered for the whole group as no cross-validation was attempted. Finally, while it was not possible to make any diagnostic sub-divisions with only 44 patients, by taking the total group of 100 patients a number of groups could be examined and compared with other reported work. This latter procedure aimed at establishing whether the present procedure compares with work carried out in a more rigidly-experimental setting, and, if so, at throwing fresh light on the use of psychomotor tests among clinical groups and in situations not previously reported.

Details of age and sex distributions are given in Table 2.2. of Phase I and Phse II subjects:

	NORMALS				PATIENTS			
	Age		Sex		Age		Sex	
	Under 40	40+	M	F	Under 40	40+	M	F
Phse I	22	12	17	17	17	27	22	22
Phase II	7	0	6	1	25	31	20	36
TOTAL	29	12	23	18	42	58	42	58

Table 2.2 - Age and Sex Distributions for the Sample.

Table 2.2 shows that among patients there were more women than men, and more older people than younger people. The sex ratio arose not only from the general finding of a higher rate of admissions among women, but also the ward in question had more female beds than male beds. Among the normal group, there happened to be a slightly higher availability of male nurses than females at the time of testing, and since most of the group was in training, their ages were lower than in the patient group. It was therefore important to take account of such differences in analysing results.

The above breakdown by age and sex was carried out in the light of strong evidence of a sex difference on psychomotor tests (e.g. Bellis 1933, Geblewiczowa, 1963). King (1954) also found a sex factor with males faster than females but described it as minimal. Hall and Stride (1954) found a highly significant sex difference among their normal

subjects which was less pronounced in the clinical population. In odd contrast, Dillon (1961) reviewing a number of studies including King's work concluded that male patients were faster than females before and during treatment, but there was no difference after.

Age has also been reported to be a significant factor since Bellis (1933) found optimal R.T. in early adulthood with a steady decline thereafter. For example, Hall and Stride (1954) concluded that "age is the most important factor accounting for the variation between groups." King (1954) also states "an age factor was clearly manifested", with the older subjects performing less efficiently than younger ones. In Leonard's (1953) study on the effect of age in relation to sensorimotor skills. He has made the important distinction on a serial R.T. task between decision time and movement time and found that it is the former which is most significantly affected by age. Singleton (1954) studied subjects right through the adult age-range and found that the fall-off due to age was gradual on decision time but quite abrupt between 50 and 60 on movement time. In this study, patients were therefore divided into those less than 40 and 40 plus, in conformity with the work of Hall and Stride, but consideration has also been given to the over 60 group in relation to Singleton's findings. The whole relationship between age and R.T. has been reviewed by Welford (1959).

More equivocal is the importance of intelligence. Early opinion appears to be that within the normal range the effect on reaction time

is negligible. (Henmon and Wells 1914., Lemmon 1927). Knehr (1954) questioned whether the findings of Rodnick and Shakow (1940) might be the result of failing to hold intelligence constant, but Tizard and Venables (1956) substantiated the earlier work by repeating it and including a group of high-grade defectives. Their conclusion was that intelligence is not an important factor since the defectives produced near-normal performances. More recently (Hermelin and Venables 1964) it has been shown that at a greater level of defect, with imbeciles (mean I.Q. 43.6) and mongols (mean I.Q. 38.6) a significantly slower R.T. is apparent.

Since this study was initiated, Shakow (1963) has written that "Reaction time does not seem to be highly correlated with intelligence. In our Worcester studies we repeatedly obtained correlation coefficients of about .30 between reaction times and I.Q. When co-operation was parcelled-out these correlations fell to about zero. In one study the correlation between set index and Progressive Matrices was only .26."

In order to shed some light on the importance of intellectual level on a clinical population, the sample has been divided according to their performance on the Mill Hill Vocabulary Scale (M.H.V.). This test is used routinely in the hospital, together with Raven's Progressive Matrices, in order to assess verbal ability and the capacity for clear thinking respectively. In view of the wide range of diseases being studied and the inclusion of some organic states, the M.H.V. level was preferred since there is relatively little decline in performance with either age or clinical state. Using M.H.V. Grades, therefore, divides the group in terms of their best intellectual level and minimises any effects due to mental

state which would have clouded interpretation.

The breakdown, seen in Table 2.3 involves only four grades, as no Grade V person happened to be included - this was quite fortuitous. The distribution among patients is skewed to the upper grades, as the group tested was largely fee-paying; the normal group is skewed the same way because they consisted of nurses and professional colleagues.

SUBJECTS	NORMALS				PATIENTS			
M.H.V. GRADE	I	II	III	IV	I	II	III	IV
Phase I	8	8	17	1	5	13	21	5
Phase II	1	4	2	0	8	13	31	4
TOTAL	9	12	19	1	13	26	52	9
Expected Frequencies in Normal Distribution	(9)	(8)	(21)	(8)	(5)	(20)	(50)	(20)

Table 2.3 - Distribution of samples on Mill Hill Vocabulary Grades.

It will be seen from Fig. 2.2 that, although there was no deliberate attempt to match the groups for verbal level, they are in fact not significantly different in distribution, (X^2 = 3.36). Attempts at diagnostic sub-divisions can never be satisfactory as long as the present terminology is in use. However, by working alongside psychiatrists, it proved necessary to use the conventional terms of reference. The diagnoses applied to these 100 patients are perhaps a little more reliable than many, since nearly all were reassessed in connection with a separate piece of research.

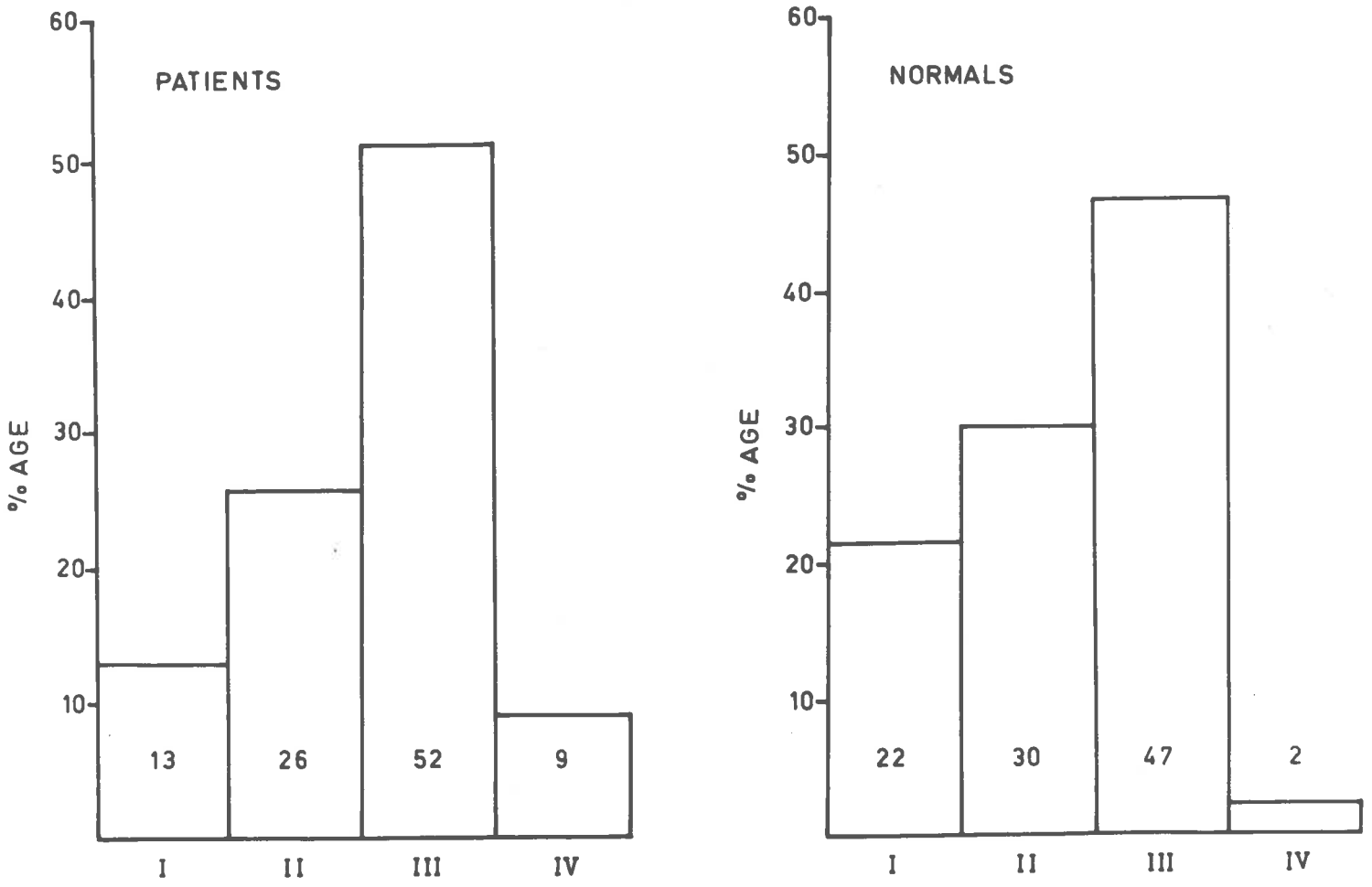


FIG. 2.2 MILL HILL VOCABULARY GRADE DISTRIBUTIONS FOR PATIENTS AND NORMALS

The categories used are based on those adopted for hospital records, with some combination of groups to achieve a meaningful number in each group. (see Table 2.4).

Category	Diagnosis	N
31	Schizophrenia	23
33 35	Manic-depressive depression Involutional Melancholia	27
34	Manic-depressive hypomania	9
36 38 47 49 50	Senile and pre-senile psychosis Epilepsy Head Injury and Sequelae Encephalitis and Meningitis Parkinson's Disease	8
37	Alcoholism	9
40 41 42 43 44 45	Anxiety Reaction Hysterical Reaction Obsessive-Compulsive Reaction Neurotic Depression Psychosomatic Other Psychoneurotics	14
46	Psychopaths and Immature Personality (character disorder)	10
		100

Table 2.4 - Diagnostic groupings.

The groupings indicated place all "endogenous" depressive states together (33 and 35), all organic states together (36, 38, 47, 49, 50) and all neurotic reactions together (40-45). This provides seven diagnostic groups, which, while not entirely satisfactory, do go together fairly meaningfully.

It is, however, important to adopt the conventions of communication unless research is specifically aimed at improving these conventions.

This main study was conducted while working in an acute psychiatric unit, where psychiatric colleagues were busy and changes in personnel were frequent. Consequently, any attempt to impose sophisticated rating techniques as criterion measures would have been doomed to failure. In addition, while ratings could have been derived for one or another diagnostic group, there is no technique available which will offer equivalent assessments of improvement for all types of acute psychiatric patients. "Improvement" in the depressed patient is very different from improvement in the epileptic or the schizophrenic. Even to ask simply for an opinion on whether improvement had occurred occasioned difficulty at times since this can occur selectively or intermittently.

While such a crude measure of change has been used to validate psychomotor results, the very crudity was inherent in the situation. It is <u>because</u> little better was available that this work has been undertaken. The possibility of a more sophisiticated rating-scale was considered, but it would have defeated its own object. If it had been brief enough for the doctor to use routinely, it would have not had the scope to cope with all diagnoses. If one had been devised to cope with every eventuality, it would have been far too cumbersome.

Following this main study, a smaller one was conducted in

which rating techniques have been used with the psychomotor battery. For this purpose it was necessary to select only one diagnostic category so that ratings could be meaningfully compared. The results of this more detailed analysis are reported in Chapter 7.

After each patient had been tested on three occasions, the psychiatrist was asked to rate the patient over the period in question, as having shown "Marked Improvement", "some improvement" or "no improvement."

(A category of "Recovered" was rejected, as it demanded too much confidence over prognosis; and a category of "Worse" was similarly avoided since the psychiatrist responsible could be expected to make such a judgement less readily than the others).

Altogether, eight psychiatrists were involved in making decisions, so the degree of agreement with psychomotor findings may well be influenced by the relative optimism and pessimism of these judges.

It will be clear that while "No improvement" and "Marked improvement" categories would be straight-forward, the middle category could be expected to provide an area of uncertainty and to be handled differently by the eight psychiatrists involved. It proved impossible to carry out an inter-psychiatrist comparison, however, since several were called upon to make only very few judgements.

It should be noted that contamination between psychological results and psychiatric ratings was eliminated. At the time of making the clinical rating, neither the psychiatrist nor the psychologist knew what level of change was indicated on the psychomotor tasks. Analysis of variance on the transformed simple R.T. data was carried out to provide a psychomotor rating long after the clinical assessment.

CHAPTER 3.

RESULTS WITH 100 ACUTE PSYCHIATRIC PATIENTS.

I. Handwriting

II. Peg-board

III. Simple Reaction Time

A. Transformation of Scores

B. Classification of Data

- Phase I

- Phase II

- Combined Results

C. Drug Effects

IV. Peg-board and Simple R.T. compared

V. Discussion

CHAPTER 3.

RESULTS WITH 100 ACUTE PSYCHIATRIC PATIENTS.

I. Handwriting.

It was postulated in Chapter I that changes in the size of handwriting would be related to mood changes in accordance with the statements of Roman (1961). Thus, among the groups examined, differences should be detected especially with depressed and hypomanic patients. However, one of the known side-effects of some anti-psychotic drugs is the appearance of micrographia so this effect must also be taken into account. (See Fig. 3.1). Since the main group of patients has not been carefully assessed for the presence of extra-pyramidal symptoms, no attempt will be made here to discriminate between these factors. The problem will be separately examined in Chapter 5.

In considering the appropriate measure of handwriting, the possibilities of using height, length or speed had to be reviewed. Preliminary observation favoured the use of length as the most commonly and consistently changing feature. The appropriateness of this choice has since been confirmed in the work of Legge, Steinberg and Summerfield (1964). In assessing the effects of nitrous oxide on handwriting they examined the value of six different measures and concluded that, in terms of test-retest reliability, ease of measurement, and sensitivity, length was to be preferred.

The measurement of "United States of America" was, therefore, in terms of overall length, which probably reflects expansiveness. It was the length of loops also which was measured rather than height,

1st OCCASION

2. United States of America UNITED STATES OF AMERICA
3. OXOXOX
4.

2nd OCCASION

2. United States of America UNITED STATES OF AMERICA
3. OXOXOX
4.

3rd OCCASION

2. United States of America UNITED STATES OF AMERICA
3. OXOXOX
4.

3·1 HANDWRITING OF A PATIENT ADMITTED ON "HALOPERIDOL"

though from time-to-time records were obtained showing a change in height with little change in length.

Normal size of handwriting on the first occasion was compared with each of the diagnostic groups in turn (Table 3.4). Significance was achieved only with the group of psychopaths who produced significantly smaller loops ($t = 2.24$: $P < .05$): approaching significance was the increased size of writing "United States of America" by hypomanics, but the group was rather small ($t = 1.66$).

Changes in size of handwriting (Table 3.4) from the first occasion to the last were significant with the depressives whose loops became larger ($t = 2.4$: $P < .05$) and the organics whose loops became smaller (perhaps better controlled) ($t = 2.5$: $P < .05$). Again the change in hypomanics' performance was almost significant ($t = 1.77$) with writing becoming smaller, but made dubious by the small sample (see, for example, Fig. 3.2).

The changes are of interest since they are in sharp contrast to the marked consistency in size of writing for normals on each occasion (see Table 3.4 and Fig. 3.3). The findings lend support to the initial hypothesis that mood changes are reflected in size of handwriting, the depressive writing smaller and the hypomanic larger than when well.

PATIENT A.L. ADMISSION. DEPRESSED

2. United States of America. United States of America

3. OXOXOX. OXOXOXOXOXOXOX

4. lllllllllllll

GOOD LEVEL

2. United States of America. United States of America

3. OXOXOX. OXOXOXOXOXOXOXOXOXO

4. lllllllllllll

SLIGHTLY HYPOMANIC

2. United States of America. United States of America

3. OXOXOXOXOXOX

4. OXOXOXOXOX

lllllllllll

3·2 CHANGES IN THE HANDWRITING OF A MANIC-DEPRESSIVE UNAFFECTED BY MEDICATION.

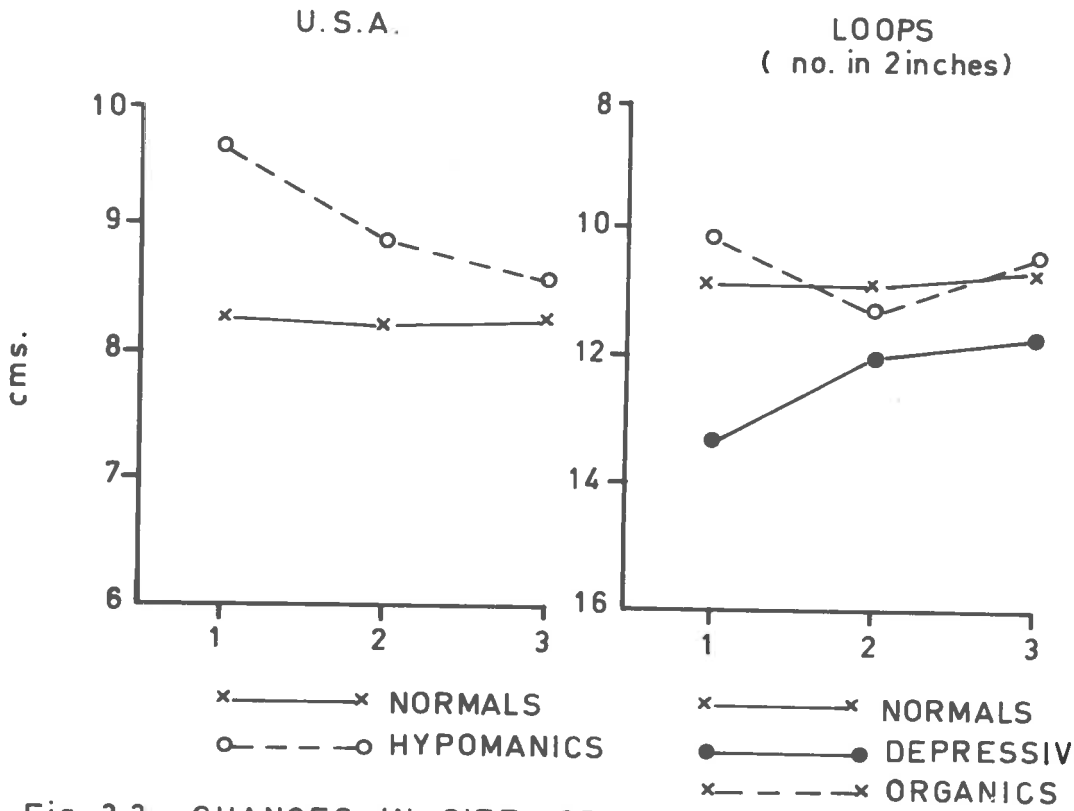


Fig. 3.3. CHANGES IN SIZE OF HANDWRITING OVER THREE OCCASIONS OF TESTING.

Group	Mean No. of Loops in 2 ins.			Mean length of U.S.A. (cms.).		
	1st occ.	2nd occ.	3rd occ.	1st occ.	2nd occ.	3rd occ.
Normals	10.85	10.90	10.59	8.26	8.24	8.28
Depressives	13.29	12.00	11.71	8.45	8.62	8.86
Hypomanics	12.88	11.40	12.00	9.65	8.93	8.61
Psychopaths	14.20	13.30	12.80	8.56	8.40	8.69
Schizophrenics	11.73	12.73	12.95	8.63	8.37	8.67
Organics	10.13	11.25	10.50	9.54	8.98	9.56
Neurotics	12.45	13.45	11.91	8.26	8.06	8.25
Alcoholics	9.11	8.77	8.33	9.90	9.36	9.27

Table 3.4 - Size of handwriting for each group on each occasion of testing.

The OXOX test, intended to assess speed of handwriting, also appeared to demonstrate differences between normals and patients and between sub-groups of patients. These results must be taken with caution however, since other influences were also at work which have not been fully controlled. For example, some of the sub-groups included a high proportion of older people. Fig. 3.4 must only be interpreted as suggestive, and taken in conjunction with findings on simple R.T. which will be outlined later in the chapter.

Fig. 3.4 indicates a steady high performance with normals together with a significant improvement among the depressives from a very

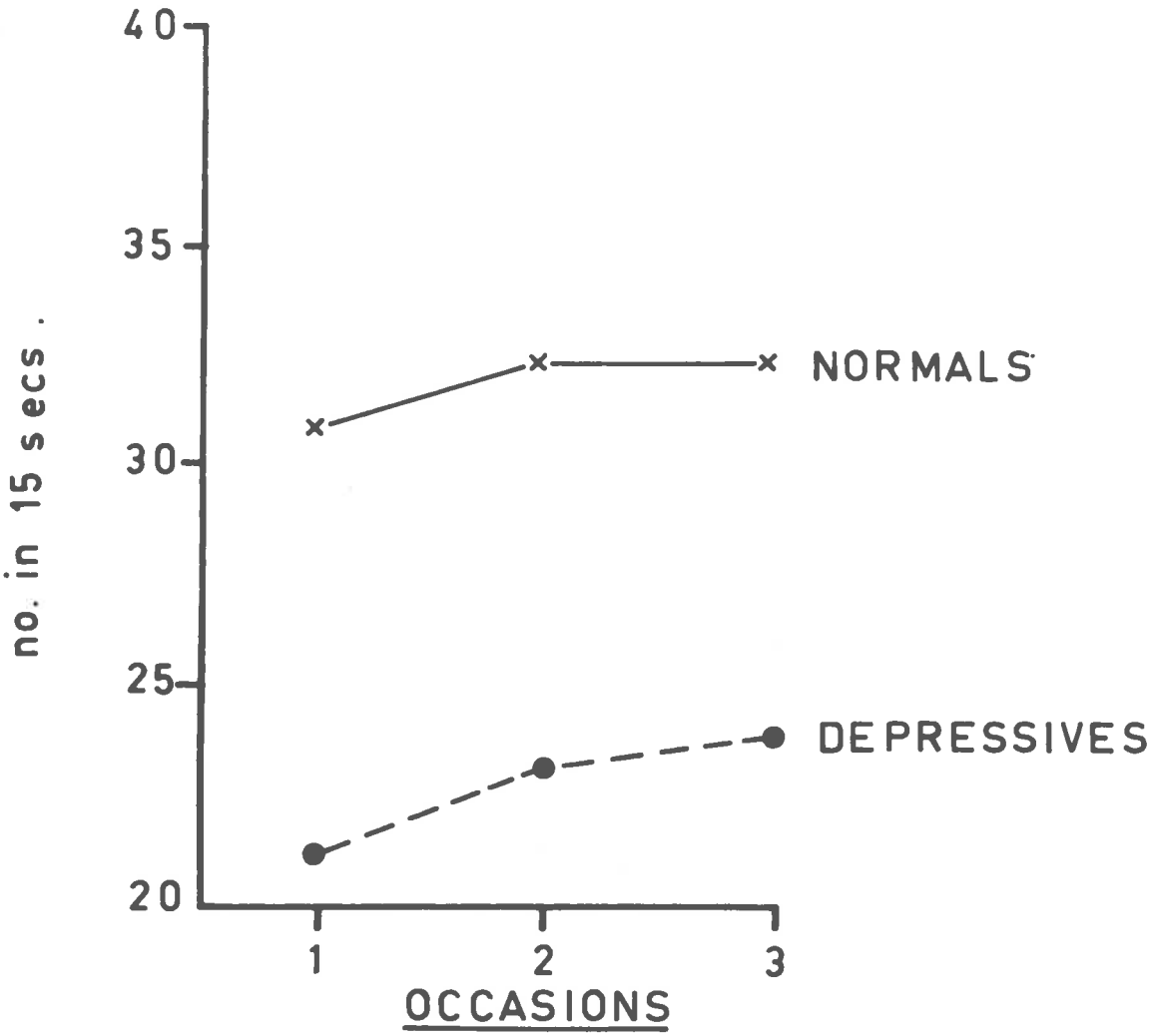


Fig. 3.4. PERFORMANCE OF NORMALS AND DEPRESSIVES IN OXOX TESTS .

poor level ($t = 2.44$: $P < .05$). It would appear that the change reflected the reduction of retardation among the depressive group. All the other groups performed significantly worse than the normal group, and did not achieve such a marked improvement in speed with treatment, although the psychopaths were only a little worse than the normals on the first occasion of testing. The relative deficits are indicated by the t values in Tables 3.5 and 3.6.

Group	Mean OXOX in 15 secs	Comparison with Normals	
		t	P
Normals	30.85	-	-
Depressives	21.08	6.67	$<.001$
Hypomanics	25.55	3.56	$<.001$
Psychopaths	27.30	2.43	$<.05$
Schizophrenics	25.22	4.52	$<.001$
Organics	19.00	7.63	$<.001$
Neurotics	21.15	6.34	$<.001$
Alcoholics	24.40	4.39	$<.001$

Table 3.5 - OXOX test performance by each diagnostic group on the first occasion, compared with normals.

II. Peg-board

Peg-board results have not been examined in detail with relation to the independent variables, of age and sex so Fig. 3.5 showing the relative performance of normals and the sub-groups of patients

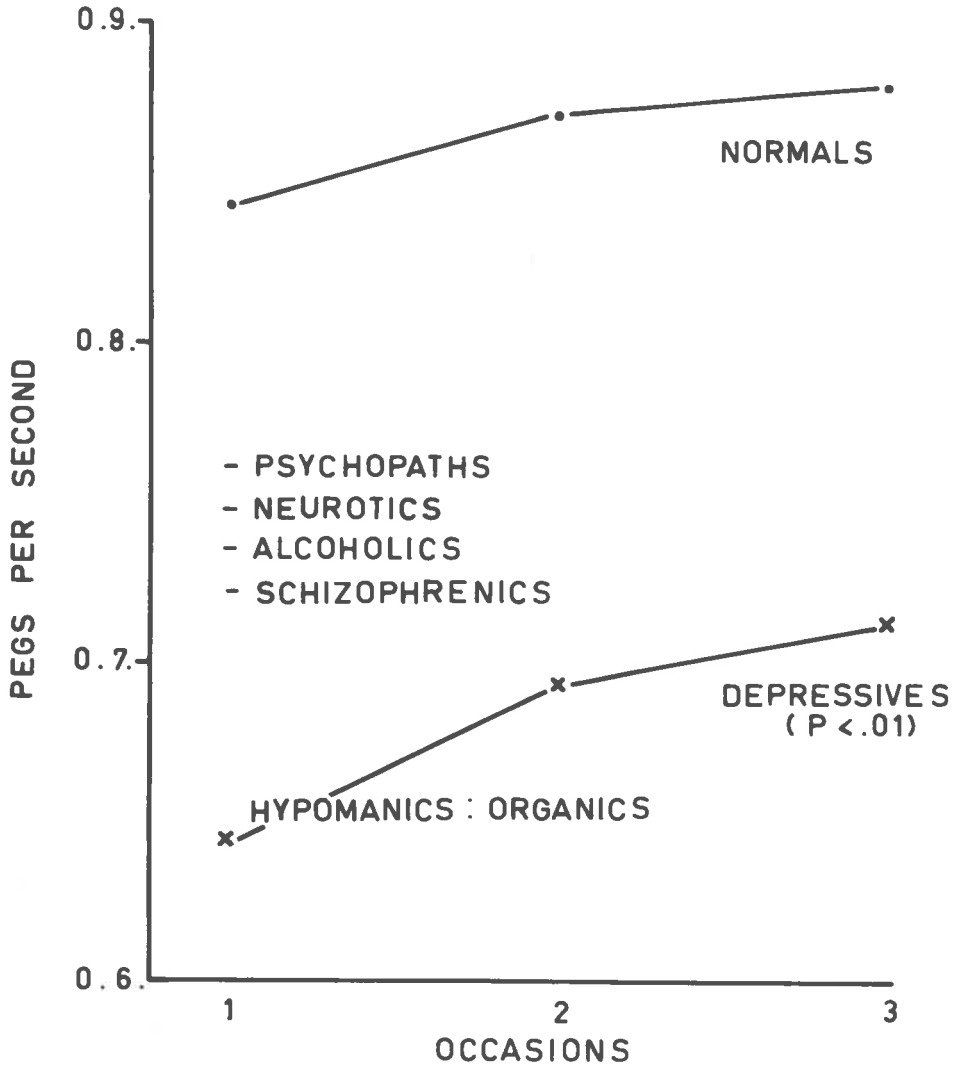


Fig. 3.5. INITIAL PERFORMANCE BY PATIENTS ON PEGBOARD, COMPARED WITH NORMALS AND A SIGNIFICANT IMPROVEMENT BY DEPRESSIVES.

should be interpreted with caution for the same reasons as the OXOX test. The only really clearcut finding is that the normals were uniformly faster than all patient groups (see Table 3.6), but the reasons for this are not apparent. Some light on this comes from a more detailed study of individual cases reported in Chapter 4, and the special implications of drug side-effects. It is clear, however, that depressives speed up with improved clinical state ($t = 7.94 : P < .001$).

The poor level of peg-board performance by patients may be taken to reflect a genuine clinical deficit, since the possibility of slowing dus to drug-effects is specifically excluded later in this chapter.

Group	Mean Speed in Pegs per sec.	Comparisons with Normals	
		t	P
Normals	0.84	-	-
Depressives	0.64	7.94	$< .001$
Hypomanics	0.65	6.56	$< .001$
Psychopaths	0.78	2.32	$< .05$
Schizophrenics	0.71	6.42	$< .001$
Organics	0.59	7.71	$< .001$
Neurotics	0.74	4.06	$< .001$
Alcoholics	0173	4.41	$< .001$

Table. 3.6 - Peg-board performance by each diagnostic group on the first occasion, compared with normals.

Peg-board performance is best compared with Hetherington's (1954) work since the same peg-board was used, and he too was studying changes in response to treatment. He compared the trends of 10 normals with 20 depressives over four occasions, the latter being treated with E.C.T.

He found a slight, non-significant improvement with his normal group, while the depressives speeded up significantly with treatment. His data are compared with the present study in Fig. 3. 6. There is striking agreement for both normals and depressives both in directional trends and in absolute levels of performance, (a time of 140 secs. is equivalent to a rate of 0.9 pegs per second; 180 secs. = .07 pegs per sec.)

III. Simple Reaction Time

Results in the R.T. situation have received a more detailed study than the other parts of the battery. This is in part because R.T. levels proved to be the best single part of the battery for making inferences about mental state. In addition, the number of variables one could analyse was greater.

By the end of three test sessions, each subject had made 60 responses, twelve to each preparatory interval.

The collection of data was organised in advance to facilitate the application of analysis of variance to the results. However, before this could be done, a transformation of scores was worked out, based on results collected in Phase I.

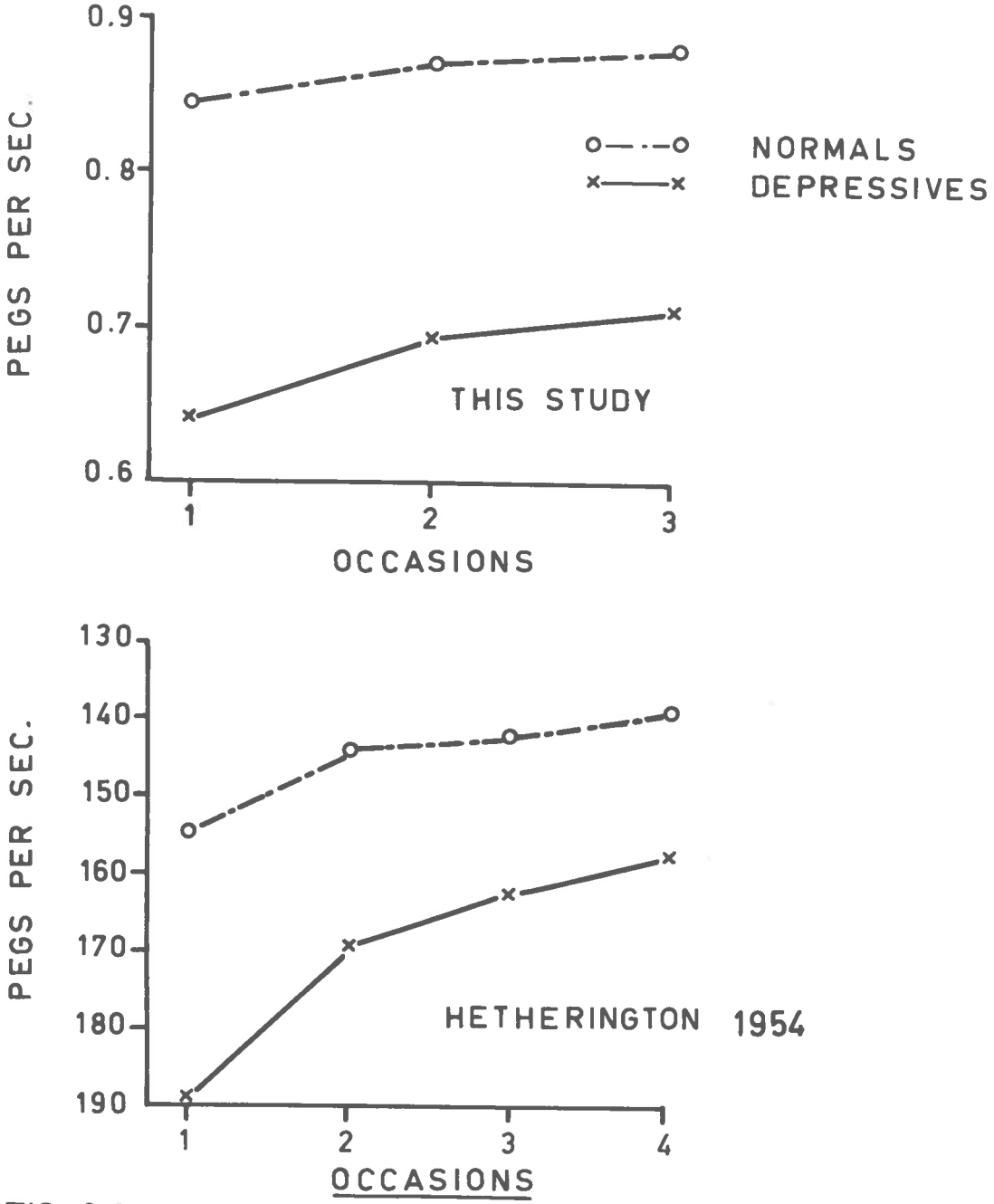


FIG. 3.6 COMPARISON OF PEGBOARD RESULTS WITH THOSE OF HETHERINGTON (1954)

4. Transformation of Scores

The distributions of raw scores for patients and normals were plotted separately (Fig. 3.7). It will be seen that these distributions are skewed and that the patients performed slower than the normals. A logarithmic transformation based on a median R.T. of 260 msecs. was adopted. The calculation to obtain transformed scores became $Y = 100 (\log_{10} 26 - \log_{10} x)$.

Such a transformation not only makes it possible to apply statistical techniques which assume a normal distribution of scores: it also makes it unnecessary to introduce an arbitrary cut-off point to exclude abnormally long R.T.s. Brooks and Weaver (1962) found it necessary to exclude all reactions longer than one second. Using raw data this is necessary to avoid artificially lengthening mean values. But such an arbitrary decision does detract from results, where it is the lengthened R.T. which is being studied. A previous attempt to apply an analysis of variance approach to data of this type was reported by Jentsch (1958) but he made a rather inadequate attempt to overcome the problem of a skewed distribution. He simply accepted that his distribution of scores for schizophrenics deviated from the normal distribution and settled for a more rigorous significance level for F. In the present study care has been taken to establish that through transforming the scores as described above, the assumptions of parametric statistics are legitimate.

This transformation is perhaps also justifiable psychologically in that absolute differences among long R.T.s seem intuitively to be of less significance than differences between short R.T.s .

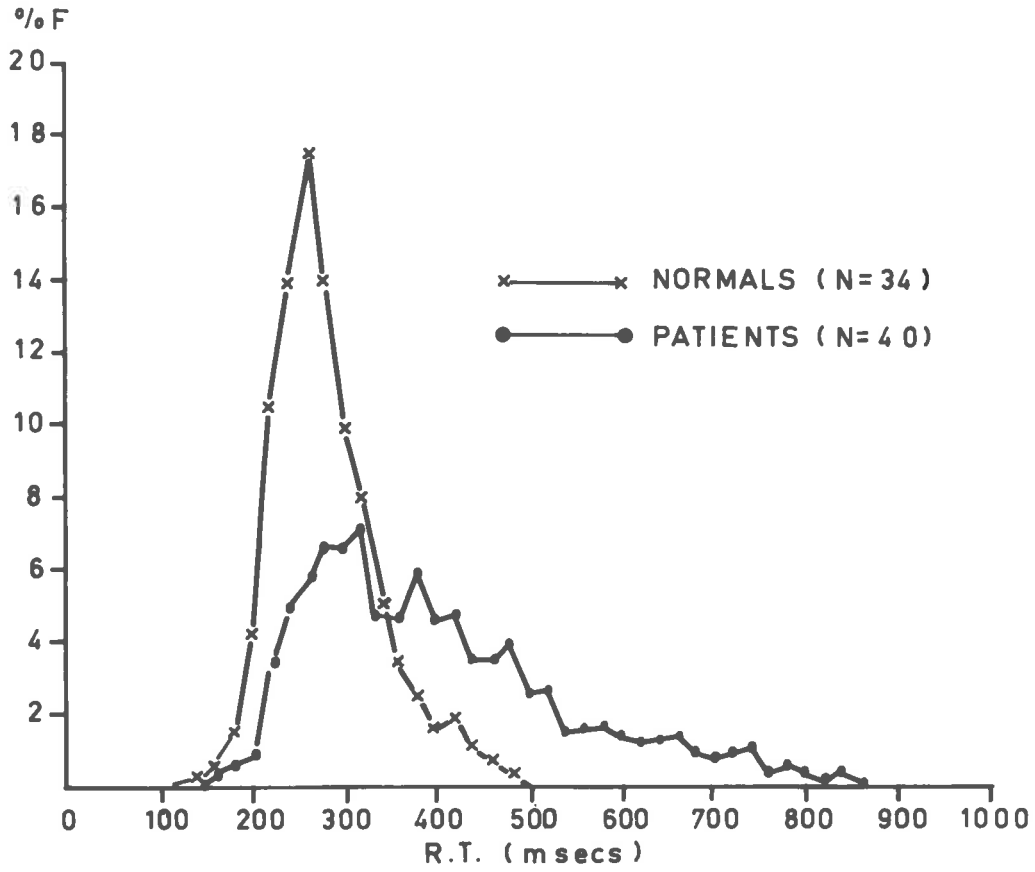


FIG. 3.7. RAW SCORE FREQUENCIES FOR PATIENTS AND NORMALS ON R.T.

Darrow (1937) has observed that psychological events are seldom linearly related to physiological effects. Biological systems tend to obey logarithmic laws.

The distribution of log. transformed scores is shown for patients in Fig. 3.8 and for normals in Fig. 3.9.

An analysis of variance was carried out on each subject's results at this stage. The sources of variance for this purpose were:

(1) W - "waiting" - the five preparatory intervals (1, 2, 4, 8 and 16 secs.).

(2) P - "progress", being the changes through three occasions of testing.

(3) "groups" - the sub-division of each block of 20 responses into fives, so that the possibility of within-trial learning or fatigue could be detected.

Only three patients and four normals showed significant changes within trials (G) so for the purpose of analyses of the groups, this source of variance was discarded as unimportant.

(B) Classification of Data

To obtain the maximum information from the simple R.T. results, they have been organised in several ways. Criteria for identifying improvement were obtained from Phase I subjects and the criteria were validated with Phase II subjects. Results for the entire group of 100 patients and 41 normals were examined individually to establish how reliable simple R.T. scores might be in the individual case.

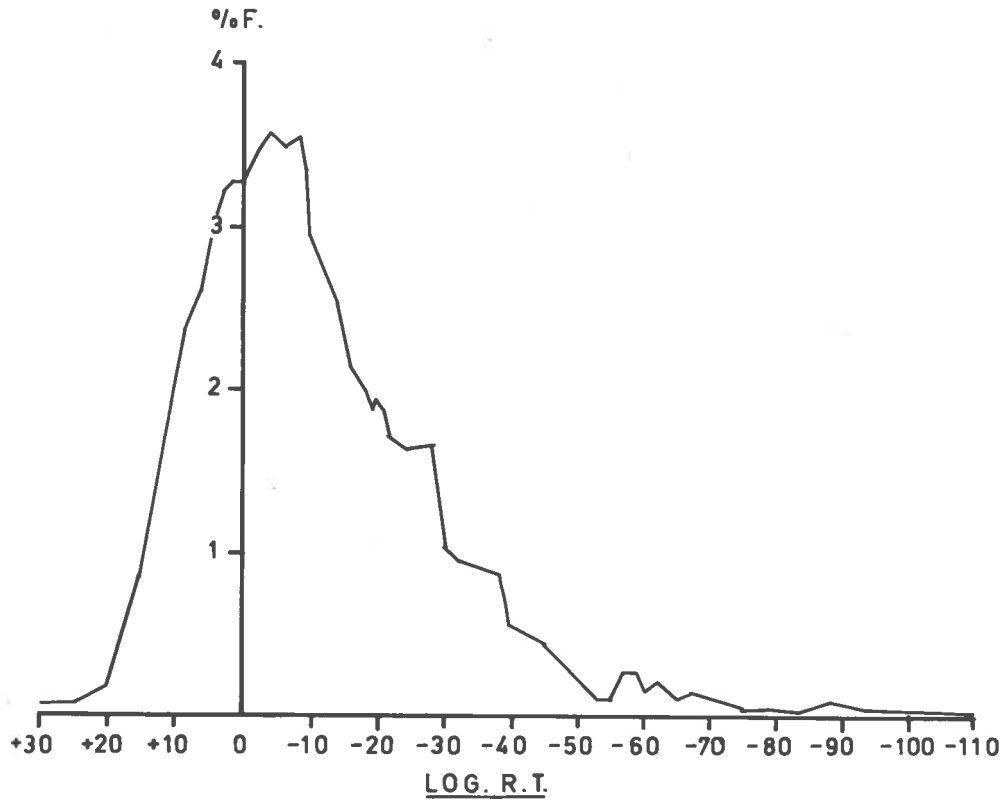


FIG. 3.8. LOG. TRANSFORMATION OF R.T. SCORES FOR PATIENTS (N=100)

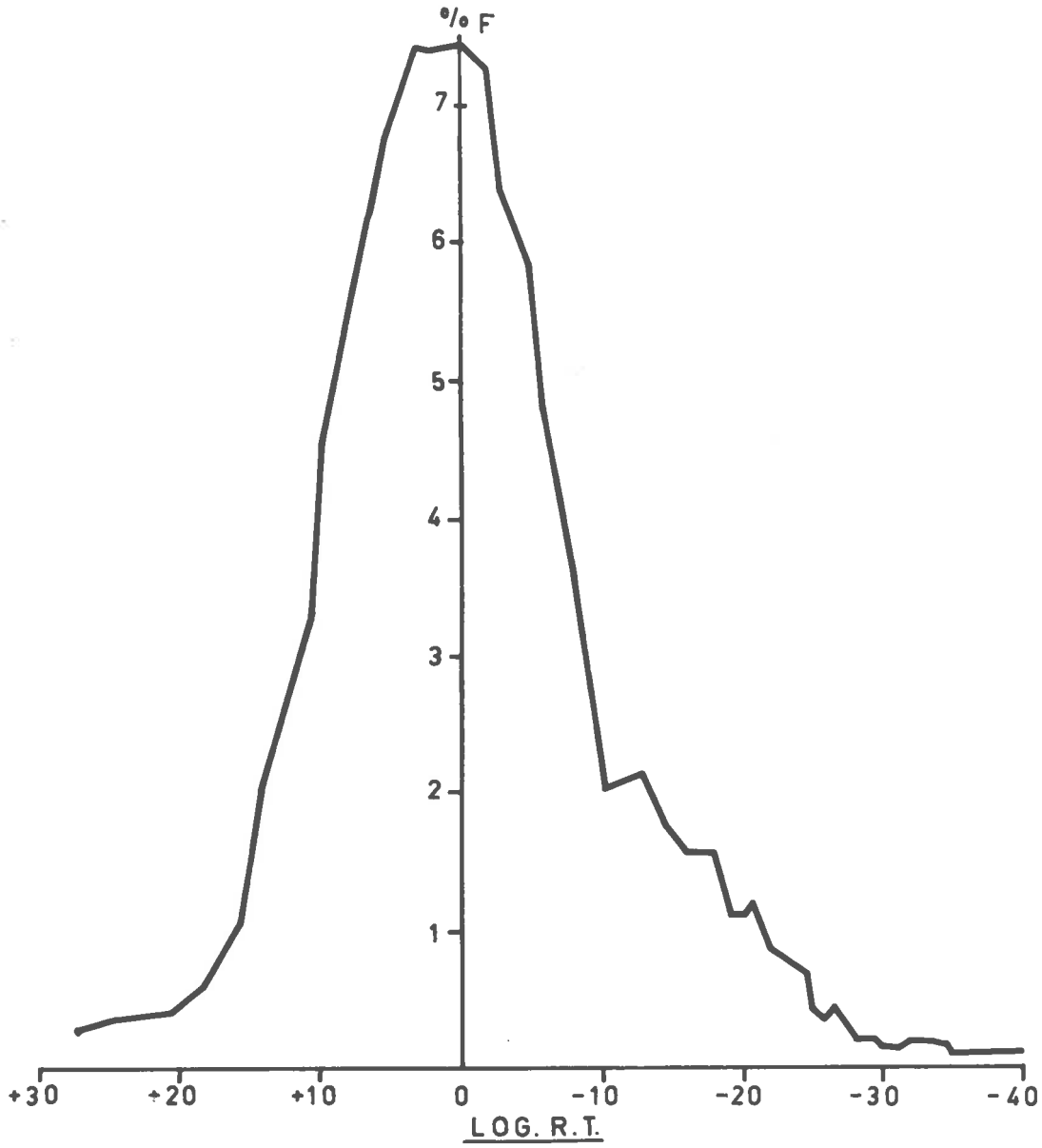


FIG. 3.9. LOG TRANSFORMATION OF R.T. SCORES FOR NORMALS (N = 41).

The series of 100 patients irrespective of diagnostic category made it impossible at the same time to conform to a design involving equal numbers in each group. Nonetheless, it was possible to identify 11 diagnostic groups with at least 7 patients per group. The functional psychoses were sufficiently represented for a distinction between males and females to be made, as well as separating out the paranoid schizophrenic from non-paranoid schizophrenic.

The eleven groups were as follows:

1. Paranoid schizophrenia
2. Non-paranoid schizophrenia - male
3. Non-paranoid schizophrenia - female
4. Manic-depressive depression - male
5. Manic-depressive depression - female
6. Manic-depressive hypomania
7. Involutional melancholia
8. Alcoholism
9. Undifferentiated neurotic reactions
10. Immature personality and character disorders ('psychopaths')
11. Organic states (3 epilepsy, 2 Huntington's chorea, 1 disseminated sclerosis, 1 head injury).

By this grouping, 77% of the total sample is included in the analysis, and this is essentially the same group as those described above.

With the normal group, the 18 females were matched with 18 males for age, by the exclusion of 5 male subjects. By dividing the groups into older and younger with a cut-off at 30 years, analysis of variance was possible to assess the relative influence of age and sex.

A similar procedure was adopted with the patient group, in which 43 males were matched with 43 females, and using an age cut-off point of 44 years.

A three-way analysis design was used (Winer, 1962, p. 338) and the results are summarised below. Table 3.7 shows the combined results of two analyses of data from normal subjects.

(i) Age x Sex x Preparatory Intervals

(ii) Age x Sex x Progress

It is clear that age has not contributed significantly in its own right to these results but sex is important, with the males performing faster than the females. Among the dependent variables, there is no significant change in performance from one occasion to the next, but the effect of various preparatory intervals is striking. The effect is largely that of the very short P.I.s which result in longer R.T.s. The trend is represented graphically in Fig. 3.10.

The data for patients were analysed in the same way as for normals, but in addition a further analysis took account of the diagnostic

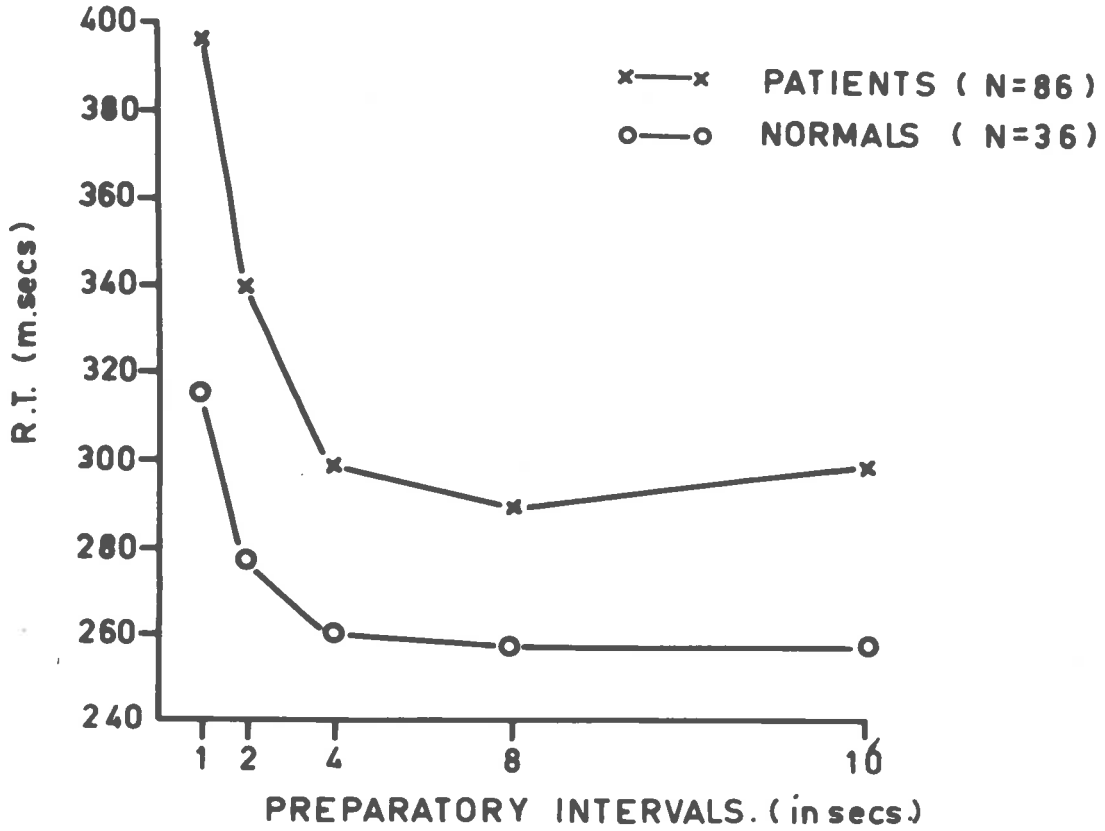


FIG. 3.10 THE INFLUENCE OF PI. ON SIMPLE R.T. FOR PATIENTS AND NORMALS .

subdivisions described above. The results analysed in terms of age and sex are contained in Table 3.8

(i) Age x Sex x Preparatory intervals

(ii) Age x Sex x Progress

Between Groups		S.O.S.	D.F.	Mean Squares	F.	P.
Age	(i)	5,894	1	5,894	0.27	N.S.
	(ii)	9,753	1	9,753		
Sex	(i)	133,716	1	133,716	6.13	<.05
	(ii)	222,859	1	222,859		
Age x Sex	(i)	13,039	1	13,039	0.59	N.S.
	(ii)	21,802	1	21,802		
Within groups effect	(i)	3,900,905	179	21,792		
	(ii)	3,799,140	107	35,505		
Within Groups						
Preparatory Intervals	(i)	328,506	4	82,126	18.09	<.001
P.I. x Age	(i)	2,507	4	626	0.13	N.S.
P.I. x Sex	(i)	8,175	4	2,043	0.45	N.S.
P.I. x Age x Sex	(i)	2,015	4	503	0.11	N.S.
Residual	(i)	739,745	163	4,538		
Total	(i)	1,345,307	179			
Progress	(ii)	34,151	2	17,076	1.4	N.S.
Progress x Age	(ii)	630	2	315	0.02	N.S.
Progress x Sex	(ii)	3,268	2	1,634	0.14	N.S.
Progress x Age x Sex	(ii)	19,956	2	9,978	0.87	N.S.
Residual	(ii)	1,135,235	99	11,467		
Total	(ii)	1,599,672	107			

Table 3.7 - Analyses of Variance on R.T. data from normal subjects (N = 36).

Between Groups		S.O.S.	D.F.	Mean Squares	F	P
Age	(i)	8,194	1	8,194		
	(ii)	13,655	1	13,655	0.06	N.S.
Sex	(i)	396,235	1	396,235		
	(ii)	660,390	1	660,390	3.13	N.S.
Age x Sex	(i)	218,046	1	218,046		
	(ii)	363,414	1	363,414	1.72	N.S.
Within groups effect	(i)	54,284,252	429	126,536		
	(ii)	53,375,553	257	207,686		
Within Groups						
Preparatory Intervals	(i)	1,638,046	4	409,511	29.97	<.001
P.I. x Age	(i)	16,114	4	4,028	0.29	N.S.
P.I. x Sex	(i)	8,408	4	2,102	0.15	N.S.
P.I. x Sex x Age	(i)	8,079	4	2,020	0.14	N.S.
Residual	(i)	5,641,632	413	13,660		
Total	(i)	13,166,172	429			
Progress	(ii)	1,166,396	2	583,198	13.36	<.001
Progress x Age	(ii)	51,567	2	25,783	0.59	N.S.
Progress x Sex	(ii)	178,961	2	89,480	2.05	N.S.
Progress x Age x Sex	(ii)	2,448	2	1,224	0.02	N.S.
Residual	(ii)	10,862,777	249	43,625		
Total	(ii)	22,284,255	257			

Table 3.8 - Analyses of Variance on R.T. data from patients (N=86).

It is to be noted that the relative influence of sex is less with the patients than with the normals to the point that F does not quite reach significance. Preparatory intervals are of importance as with the normals but with an even greater difference between short and long P.I.s (see Fig. 3.10). There is also a slowing with the 16 second P.I. among patients as a whole of the type that has been reported for schizophrenics (Zahn, Rosenthal and Shakow (1963)) and related to their inability to maintain an appropriate set.

The major difference between the analyses for normals and patients is found in the Progress effect. Whereas with normals the results on repeated testing did not differ significantly, among the patients there is a highly significant trend towards improvement on each occasion. The mean levels for each occasion for patients and normals are shown in Table 3.9.

	Occasions		
	1	2	3
Patients (N = 77)	301.8	280.5	274.7
Normals (N = 36)	260.8	260.4	260.2

Table 3.9 - Changes in R.T. levels for patients and normals on three occasions of testing.

This change from occasion to occasion is in line with the initial hypothesis that improvement in clinical state would be reliably measured

by levels of simple R.T. Two factors have to be examined more carefully in considering the importance of this trend:

(i) the fact that only some patients improved clinically while others failed to improve - the extent to which a relationship exists and their clinical status will be examined in the next section of this chapter;

(ii) the influence of diagnosis. One might expect different trends among different diagnostic groups. This will now be considered in the light of a further analysis of variance (see Table 3.10).

Between Groups	S.O.S	D.F.	Mean Squares	F	P
Diagnosis	422,352	10	42,235	0.90	N.S.
Within group effects	53,708,937	1,154	46,541		
Within Groups					
Preparatory Intervals	530,367	4	132,591	66.43	<.001
Progress	356,722	2	178,361	89.36	<.001
P.I. x P	12,648	8	1,581	0.79	N.S.
P.I. x D	29,894	40	747	0.37	N.S.
P. x D	155,761	20	7,788	3.90	<.001
P.I. x P x D	29,026	80	362	0.18	N.S.
Residual	1,995,863	1,000			
Total	5,442,665	1,154			

Table 3.10 - Analysis of Variance on R.T. data from patients subdivided into diagnostic categories.

The most important observation is that diagnosis is not a significant source of variance in itself, nor is the interaction between preparatory intervals and diagnosis. Such an observation is entirely consistent with King's observation (1961) that "measures of some of the simplest psychomotor functions may serve as an index of what might be called total organism integrity or effectiveness." It does, on the other hand, call into question the value of making interpretations about the nature of specific deficits in one or another diagnostic category. The implication of these findings is that if one samples the performance of psychiatric patients widely enough, a deficit of simple psychomotor functioning is found, and the nature of the deficit is indistinguishable from one group to another. Such an assertion may appear to contradict the assertions of Shakow, that a deficit specific to schizophrenics can be detected using R.T. measures. However, it is to be noted that Rodnick and Shakow (1940) first drew attention to the cross-over phenomenon among chronic schizophrenics when comparing regular with irregular P.I.s These findings, though questioned by Knehr (1954), have been confirmed by Tizard and Venables (1956).

While in this study, regular P.I.s have not been used, it is possible to compare the irregular warning situation, since the selection of P.I.s of 1,2,4, 8 and 16 seconds was largely determined by their work.

Fig. 3.11 shows the levels of response at different P.I.s, found by Rodnick and Shakow (1940), Lizard and Venables (1956), and in this study.

It is apparent that the normal subjects in all three studies perform at much the same level with P.I.'s of 4 seconds and longer, while the shorter P.I.s produce longer R.T. The absolute level of performance is slower in this study; this could be related to the nature of the stimulus and because the 25 sec. interval used in the other studies was not included here.

With patient groups, the absolute level is governed both by the severity of the disorder and the fact that the early studies have been with chronic patients. The better level of performance of the early schizophrenic is in accordance with the findings of Huston and Senf (1952) and Zahn and Rosenthal (1965). The shapes of the curves for both patients and normals are very closely similar to those of Rodnick and Shakow.

The curve for acute schizophrenics reported by Zahn and Rosenthal (1965) shows the same features as in this study with the exception that the mean levels for each P.I. are around 150 msecs. slower in this study. This difference clearly results from

(a) the use of a visual stimulus rather than an auditory one

(b) the inclusion of both male and female subjects - Zahn and Rosenthal's subjects were all male

(c) all the patients were acutely ill and recently admitted, whereas Zahn and Rosenthal "felt that many S's in the

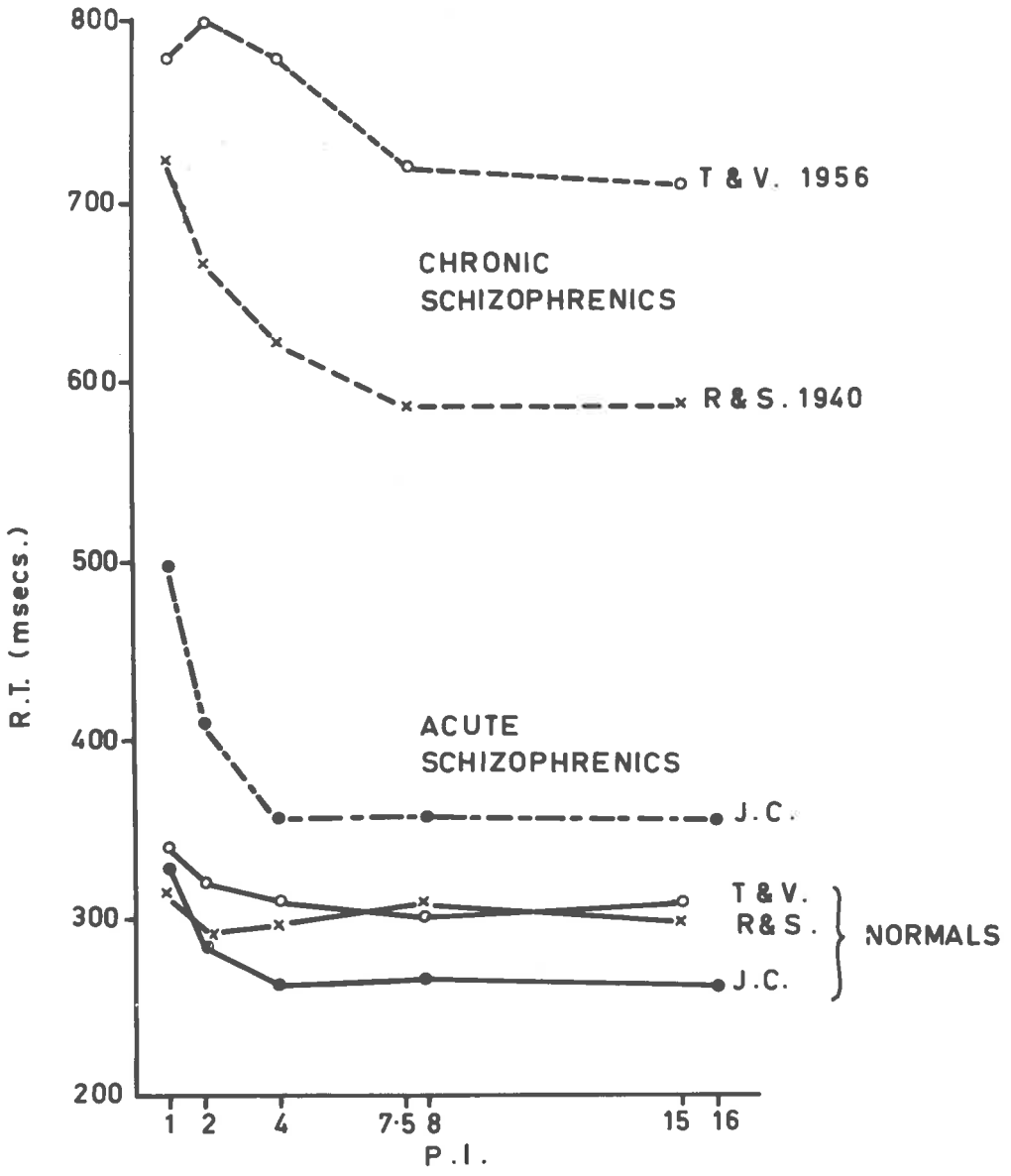


FIG. 3.11. COMPARISON OF RESULTS WITH THE WORK OF TIZARD & VENABLES (1956) and RODNICK & SHAKOW (1940).

schizophrenic group were in partial or even complete remission at the time of testing."

King's (1954) major contribution includes distribution curves of R.T. raw scores for the various sub-groups under discussion. Allowing that his stimulus was an auditory signal, whereas the stimulus in this work was visual, results are remarkably similar for normals (Fig. 3.12).

The performance of this group of 100 patients has been compared with King's schizophrenic group, and with a similar group of chronic patients reported by Brooks and Weaver (1962). (Fig. 3.13).

The distribution of raw scores is much more platykurtic for all these groups: it is again evident that a psychomotor deficit is found in the generality of diagnoses. Such a distribution emphasises the need for a transformation of scores before using analysis of variance as a statistical tool (a precaution apparently omitted in the Brooks and Weaver study).

One significant interaction with diagnosis does emerge, and that relates to progress. Some diagnostic groups behave differently from others in terms of the rate of change of level of performance. These differences are represented graphically in Fig. 3.14 (the functional psychotic groups) and Fig. 3.15 (the other diagnostic groups).

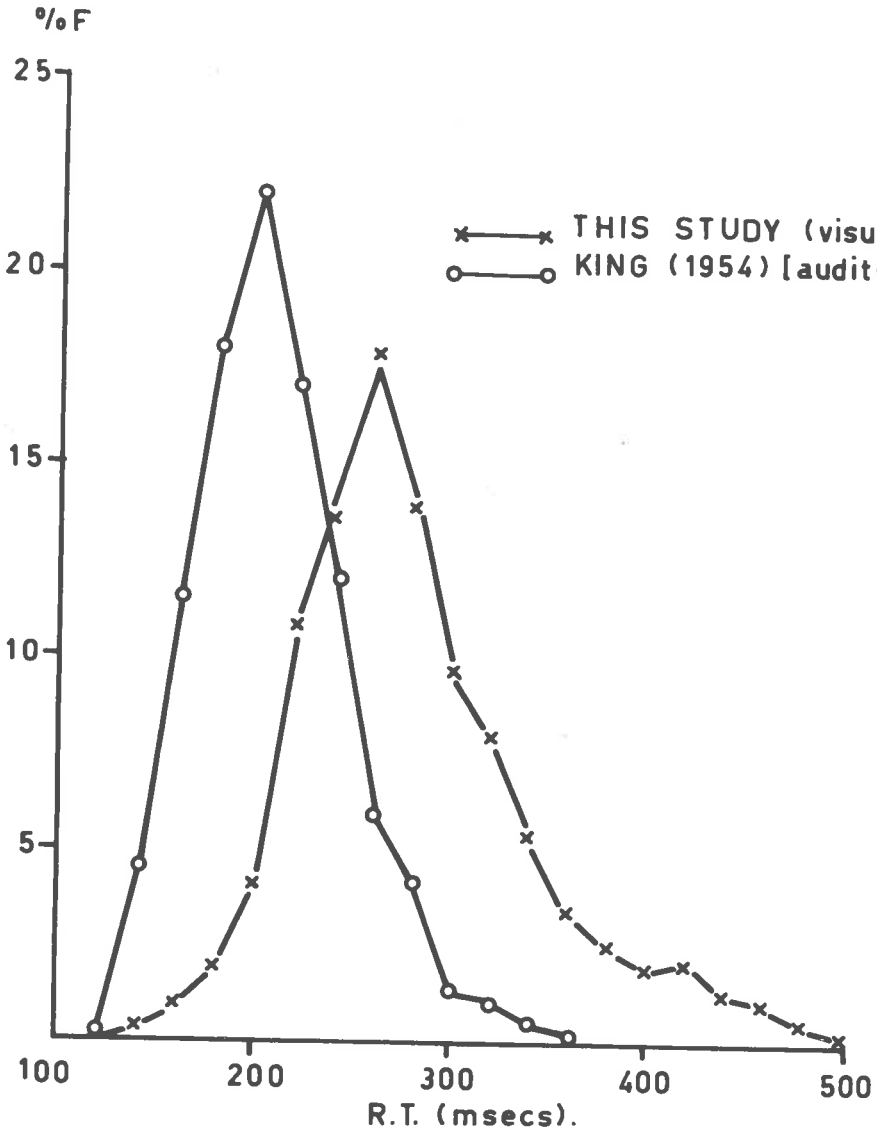


FIG. 3.12 COMPARISON OF R.T. DISTRIBUTION FOR NORMALS WITH KING (1954).

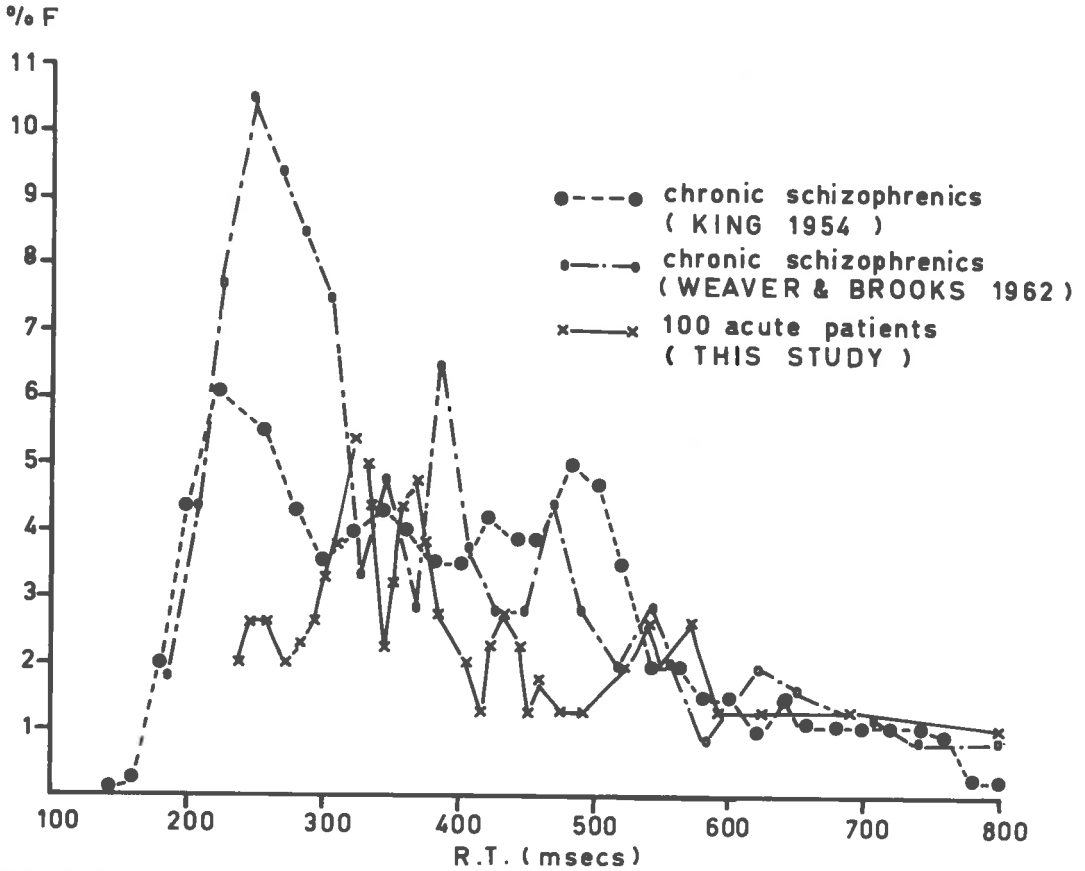


FIG. 3.13. COMPARISON OF R.T. RESULTS WITH THOSE REPORTED BY KING (1954) AND BROOKS & WEAVER (1962)

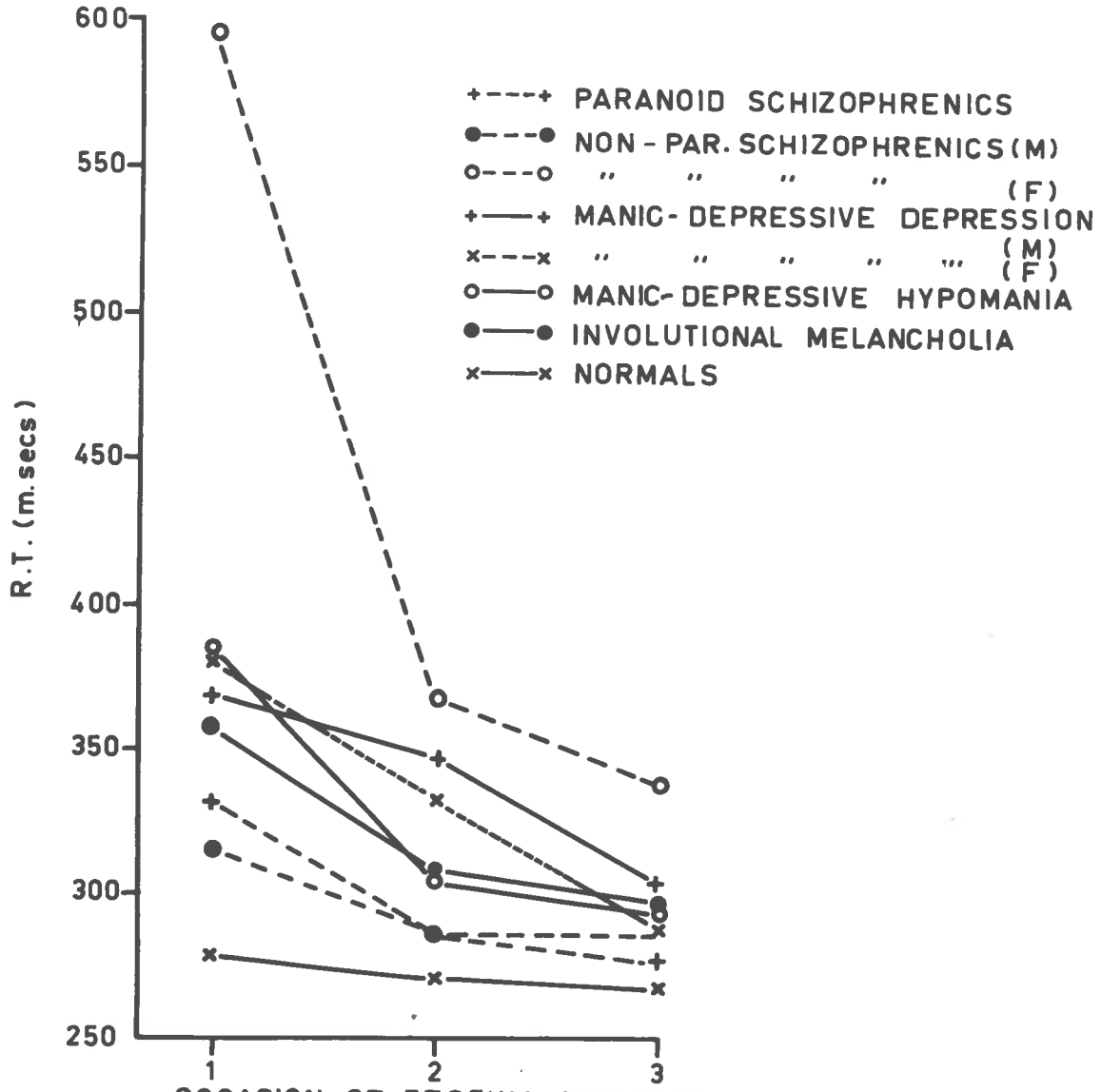


FIG. 3.14 CHANGES IN LEVELS OF R.T. PERFORMANCE AMONG FUNCTIONAL PSYCHOTIC GROUPS.

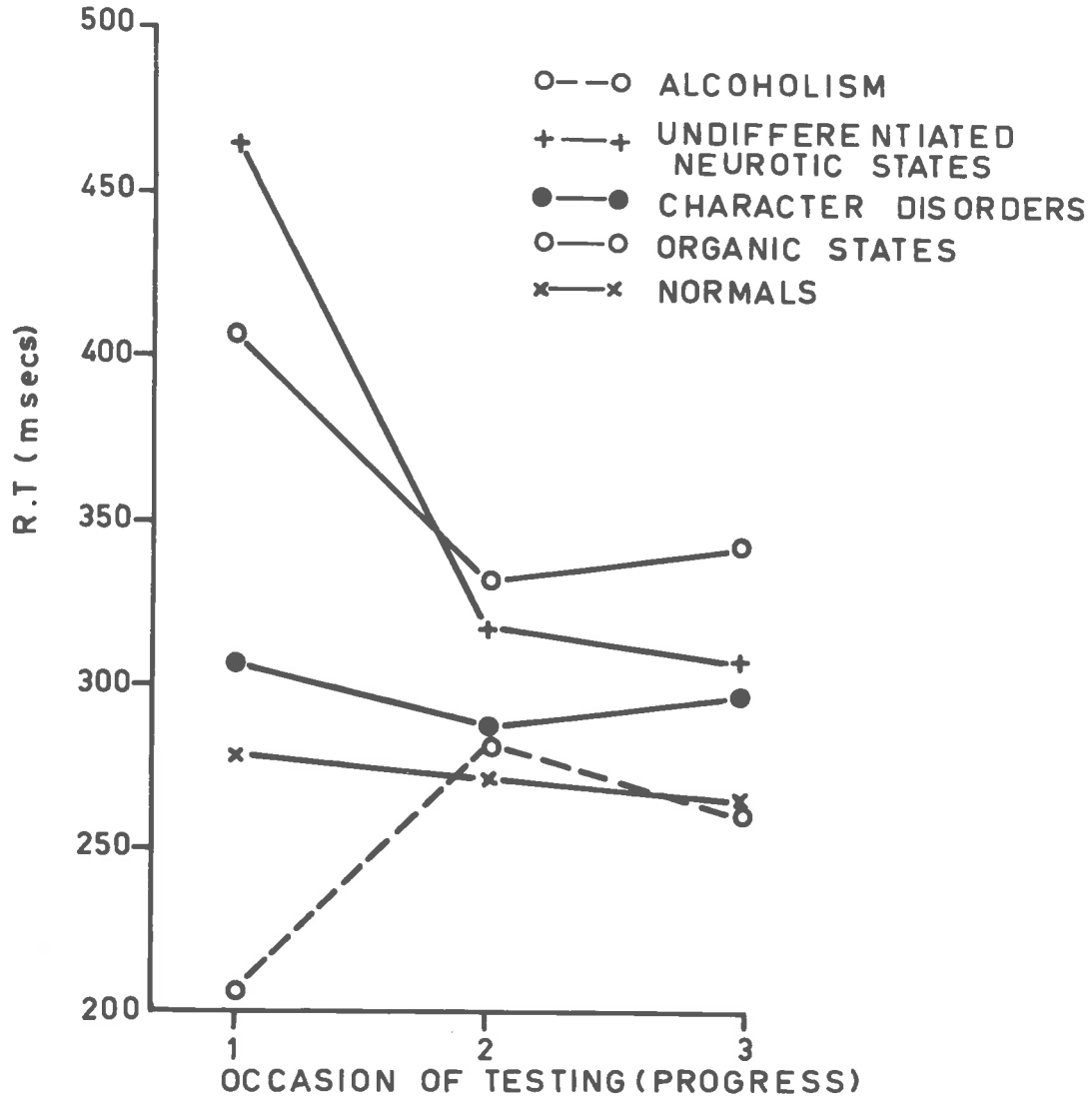


FIG. 3.15 CHANGES IN LEVELS OF R.T. PERFORMANCE AMONG PATIENTS OTHER THAN FUNCTIONAL PSYCHOTICS .

The trend for most of the patient sub-groups was a steady improvement through the three occasions of testing. This is consistent with the clinically-observed improvement which takes place in most acute psychiatric patients over a 6-week time span following admission. It is of interest to note where other trends are apparent. A more striking improvement during the first interval of time is seen with the acute female schizophrenics (non-paranoid) and the acute neurotic patients. The greatest therapeutic benefit appears to occur within three weeks. The neurotic group then progresses to a level close to normal, while the schizophrenic group remains significantly worse than all the other groups except the organics. The organic group shows an initial marked deficit and although some improvement is achieved, residual impairment remains. This too is consistent with clinical experience. The group is too small and heterogeneous to make generalisations beyond this.

The only other group which stands out is the alcoholic group. It is clear that psychomotor testing is an inappropriate means of measuring whatever changes take place in such a group. Their overall level is indistinguishable from normal - indeed it is faster than the normative group on the first occasion, but since they are all males this is as one would expect. This is the only group to do worse on subsequent occasions of testing and motivation is probably the explanation for this.

Phase I Findings - Individual Reliability

From the variety of measures that might have been used, the level of significance of the F ratio of progress (F_p) was adopted as a way of determining how much variance was related to progress on three separate occasions. This measure was derived from the analysis of variance carried out on each subject's R.T. results. Variance ratios were obtained relating to preparatory intervals, groups of responses within each test session, and "progress", being the changes occurring through the three occasions of testing. A high F_p value indicates that a large change has occurred between occasions of testing, but three difficulties arise if one uses this measure in isolation:

(i) Sometimes changes took place only in speed of response to short P.I.s. This could result in a significant variance ratio for preparatory intervals (Fw) yet a relatively low F_p value. Yet, as will be shown later, this type of change is a most important one clinically.

(ii) High F_p values can indicate a marked <u>decline</u> as well as a marked improvement in performance. It is, therefore, necessary to ensure that the <u>direction</u> of change is noted when relating it to a clinical assessment.

(iii) The initial level of R.T. is important in considering the Fp value. There is a difference between the person who moves from "bad" to "good" and the one who moves from "good" to "better", though the F_p values may be the same.

Two separate parameters were therefore used to identify those who could be rated as "improved"

(a) the Fp value

(b) the mean R.T. score on the first occasion of testing.

The following objective procedure has, therefore, been adopted on the assumption that sex is an important variable, as was shown in Table 3.7. Patients were divided into three groups: those clinically rated as "no improvement", "some improvement" and "marked improvement". Each patient's results were than scrutinised in relation to the F_p ratio (progress) and the mean log. score on the first occasion of testing, and by inspection criteria were set up as follows:

(a) $F_p < 2.5$ taken to reflect "no improvement"
(This happens to correspond to a 5% significance level).
F_p from 2.5 to 6.25 taken to reflect "some improvement".
$F_p > 6.25$ taken to reflect "marked improvement".

(b) Patients were only assumed to show improvement if the initial mean R.T. score was poor - specifically, for males a mean R.T. of 275 msecs., for females 290 msecs.

Table 3.11 shows what happens when the F_p value is taken, but no account is taken of the initial mean R.T. for each subject.

Doctors' Rating	Simple R.T. (F_p level)			
	Nil	Some	Marked	
'Nil'	12 (14)	0 (11)	2 (9)	14(34)
'Some'	2	4	5	11
'Marked'	1	5	13	19
	15	9	20	44

Table 3.11 - Comparison of Psychiatrists' and R.T. ratings using only F_p values (Normals in brackets).

Using criteria which take no account of initial performance, 20 of the normal subjects are "misclassified". Table 3.12 shows what happens if one combines information about initial performance with the Fp value.

Doctors' Rating	Simple R.T. (Fp and Mean R.T.)			
	Nil	Some	Marked	
'Nil'	12 (25)	0 (3)	2 (6)	14 (34)
'Some'	3	4	4	11
'Marked'	3	4	12	19
	18	8	18	44

Table 3.12 - Comparison of Psychiatrists' and R.T. ratings using both criteria (Normals in brackets)

Little difference is seen in the patients' distribution, but it does result in a better classification of normals, with only 9 now apparently showing improvement. Comparing 'Improved' with 'Not Improved' categories, 82% of patients are correctly classified.

Good's (1950) Exact Test was carried out on this distribution, showing that there is a significant association between R.T. changes and what the psychiatrist says about mental state. ($P < .05$).

This association is somewhat artificial, however, since the criteria were retrospectively determined to provide the best possible agreement with the clinical rating. To determine whether this measure has any real value, a cross-validating group had to be obtained.

Phase II Findings - Validation of Scoring Criteria.

With criteria of judgement determined, a further group of 56 patients was tested, and a small group of 7 normals. The purpose of this was partly to provide validation for a procedure which had an empirical basis, and partly to enlarge the sample to the point where a diagnostic breakdown would be possible. The patient group was drawn from the same admission unit; Tables 2.2 and 2.3 show a strong similarity between the PhaseI and Phase II groups in terms of age, sex, and M.H.V. level.

Table 3.13 shows the efficiency of the pre-determined criteria on this second-group of 56 patients.

Doctor's Rating	Simple R.T. F_p and Mean R.T.			
	Nil	Some	Marked	
'Nil'	8 (6)	0 (0)	1 (1)	9 (7)
'Some'	11	1	9	21
'Marked'	6	1	19	26
	25	2	29	56

Table 3.13 - Comparison of Psychiatrists' and R.T. rating on the cross-validation group. (Normals in brackets).

The procedure is seen to continue working well with the normal group, only 1 person being misclassified. The patient group shows a good relationship between the two ratings. The most important area of disagreement is found where the doctor indicates some or marked improvement, while the R.T. rating indicates nil. Seventeen patients fall into this group and clearly this needs explanation. Inspection reveals that the discrepant subjects were almost without exception diagnosed as depressives and receiving E.C.T.

No attempt has been made to change the technique, as the problem appears to be largely related to the one diagnostic group. This will be considered further when diagnostic differences are presented.

One other psychologically significant explanation is put forward for patients being rated differently by psychiatrist and R.T.

It is likely that the R.T. is sometimes more sensitive to change than a clinical view (this will be seen in Chapter 4). Hall and Stride (1954) formed the same impression, stating that "this relationship trend was not apparent in all cases, improvement in R.T.'s sometimes seeming to precede overall clinical improvement, and conversely, lengthening of R.T.'s sometimes preceded clinical deterioration." The 10 patients rated "Marked Improvement" on R.T., but only "Some" or "Nil" by the psychiatrist could be of this type.

Combined Phase I and Phase II Results - Group Reliability.

Since the criteria adopted with the first phase have worked at least as well with the second phase, it is now possible to take the whole group of 100 patients and 41 normals to see what relationship exists between ratings. This is shown in Table 3.14.

Doctors' Rating	Simple R.T. F_p and Log. Mean			
	Nil	Some	Marked	
'Nil'	21(31)	0(3)	2(7)	23(41)
'Some'	15	5	12	32
'Marked'	9	6	30	45
	45	11	44	100

Table 3.14 - Comparison of psychiatrist's and R.T. ratings for the whole groups. (Normals in brackets).

76% of normals are correctly classified.

56% of patients' R.T. results coincide exactly with the Psychiatrist's rating; a further 18% show approximate agreement. With 26% there is disagreement.

Using Good's Exact Test this was found to be a highly significant relationship ($P < .001$).

At this stage it is appropriate to sub-divide the 100 patients into diagnostic categories to see if the agreements and disagreements shown in Table 3.14 relate to specific diagnoses. The literature would suggest maximum concordance among the psychotics.(Wulfeck 1941, Huston and Senf 1952, Hall and Stride 1954, King 1954).

Table 3.15 presents, for the sake of simplicity, a breakdown of results in terms of "Improvement" or "No Improvement" (i.e. taking no account of quantity of improvement).

Diagnosis	N	Dr.Nil R.T.Nil	Dr.Impr. R.T.Impr.	Nil Impr.	Impr. Nil	%age agreement	%age disagreement
Schizophrenics	23	5	15	0	3	87	13
Hypomanics	9	1	8	0	0	100	0
Depressives	27	2	15	0	10	63	37
Organics	8	2	5	1	0	83.3	16.7
Total Psychotics	67	10	43	1	13	79.1	20.9
Alcoholics	9	1	3	1	4	44	56
Neurotics	14	3	7	0	4	71	29
Psychopaths	10	7	0	0	3	70	30
Total	33	11	10	1	11	62	38

Table 3.15 - Psychiatric and R.T. ratings related to diagnostic categories, and using both criteria (Fp + initial mean R.T.).

Table 3.15 shows:

(i) Greater agreement between ratings among the psychotics than among the other patients, suggesting that the deficit is characteristic of psychosis.

(ii) Agreement is complete among the hypomanics, suggesting that the psychomotor approach is particularly appropriate with manic-depressives.

(iii) In only two cases did the R.T. rating indicate improvement where none was seen clinically. This suggests that the criteria of improvement adopted here obviate against false positives.

(iv) Conversely, 10 depressive patients are shown as not improving by the R.T. criteria, which have been adopted, whereas clinically they were. Since this group consists of two categories (manic-depressive depressions and involutional melancholias) they were inspected for differences of precise diagnosis, but no association emerged. Neither was there any obvious relationship suggesting that retarded depressions were more accurately assessed than those characterised by agitation.

What does emerge from going back to the original records is that of the ten depressed patients misclassified, nine were recorded as receiving E.C.T., while it is not clear about the tenth (a 59 year old hypochondriacally depressed lady who almost certainly was treated with E.C.T.). Thus the failure to detect improvement on simple R.T. where psychiatrically improvement was evident can perhaps be related to the con-

fusional effects of E.C.T. Although the actual day of treatment was carefully avoided, the side-effects last much longer than this. One may conclude that when electrical treatment is being given, simple R.T. cannot be taken as a reliable indicator of improved psychiatric status. This issue has been analysed in greater detail in a further study, reported in Chapter 7.

v. Among the psychopaths, the R.T. rating did not indicate improvement on any occasion - in some cases, in fact, their mean level became poorer. For this small group, the test situation seems to have provided a sample of behaviour which is clinically meaningful, but there is no evidence of a psychomotor deficit whose changes can be measured. Motivation is probably a significant source of variance in this group.

(vi) Similarly with the alcoholics, a simple R.T. measure does not give reliable information about change of state. The degree of concordance is at the chance level.

The criteria for determining clinical change have deliberately been made as rigorous as possible, and based on the assumption that any given subject may be either a patient or normal. However, if one knows a subject is a patient, the second criterion involving initial mean R.T. can be disregarded. In the case of the depressives, if both criteria are used, 63% are assessed accurately. If, however, one makes the initial assumption that a deficit

exists, only the Fp level needs to be considered and accuracy improves to a level of 74%, while the overall agreement for psychotics improves 86.6% and disagreement to 13.4%. The breakdown for psychotics by diagnostic categories is shown in Table 3.16

Diagnosis	N	Dr.Nil R.T.Nil	Dr.Impr. R.T.Impr.	Nil Impr.	Impr. Nil	%age Agreement	%age Dis-Agreement
Schizophrenics	23	5	17	0	1	95.7	4.3
Hypomanics	9	1	8	0	0	100	0
Depressives	27	2	19	0	6	77.8	22.2
Organics	8	1	5	2	0	75	25
Total	67	9	49	2	7	86.6	13.4

Table 3.16 - R.T. performance of psychotics compared with clinical assessment, irrespective of initial R.T. level

C. Drug Effects

While the effects of drugs on psychomotor performance are beyond question, no adequate account has yet been taken in this study of the fact that many patients were receiving medication on admission, while none of the normal subjects were. It might, therefore, be tempting to argue that any deficits detected could be accounted for by the quantity of drugs being administered.

The objection can be answered in several ways.

(i) The concordance of psychiatric and R.T. ratings indicates that something clinically meaningful is being measured. Patients on drugs throughout their treatment improved their mean R.T. level if they were getting better, but did not if their clinical state remained unchanged. The significant agreement of these two independent ratings argues strongly against effects being due simply to sedation.

(ii) Where it is possible to compare these results with published findings, trends and mean levels are comparable. This line of argument makes it unlikely that these results are chance findings with fluctuations determined by medication changes.

(iii) An analysis of the effects of one drug ('Haloperidol), described in Chapter 5, suggests that while handwriting and the peg-board were affected, the mean R.T. level was affected little or not at all. This does not however, exclude the possibility that such drugs as barbiturates would significantly depress performance.

It is evident from the literature referred to in Chapter 1, that the effects of drugs on psychomotor performance are not clearly defined. Much careful experimental work is needed before it will be possible to generalise.

(iv) In this study it has been assumed that, if drug effects are present, they are less important than the factors under special review. The variety, mixtures and dosage differences were so great that a separate study would have been necessary to do them justice.

All that could be done was to note which patients were receiving drugs of any sort when first tested and which were not. 36 patients were noted to be receiving some form of medication on admission, so a matched group from the remainder has been attempted to determine whether drug effects have made a major contribution to the results. (The doubtful assumption is made here that those who were not on prescribed drugs were not taking significant quantities on their own initiative).

Matching was carried out by age, sex and diagnosis. It proved possible to match 21 patients by these criteria, and compare their initial performance on each of the sub-tests of the battery. All the seven diagnostic categories were represented in this group: there were also representatives of all levels of clinically-assessed improvement. Results of this matching are presented in Table 3.17.

Tests	Drug groups means	No-Drug group means	t	Significance.
U.S.A.(Size)	8.93 cms.	8.94 cms.	0.002	N.S.
Loops (Size)	13.3	10.7	1.59	N.S.
OXOX (Speed)	25.0	21.7	1.72	N.S.
Pegs (Speed)	0.72 per sec.	0.69 per sec.	1.21	N.S.
R.T. (Speed)	340 msecs.	370 msecs.	1.53	N.S.

(N = 21)

Table 3.17- Comparison of matched groups at first testing, on each psychomotor test.

From these results, it would appear that drug effects are, for the purpose of this study, relatively unimportant. It is probable that they are not so much absent as that they cancel each other out. Since the two groups together account for nearly half the patient population studied, it is clear that large changes are the result of changes in mental state rather than changes in medication. A similar absence of drug effect has been noted by Stotsky (1957) who found that with schizophrenics, the clinical status of the patient far outweighed the presence or absence of chlorpromazine, and by Zahn and Rosenthal (1965) who compared two groups of acute patients and found "the patients on drugs had slightly but not significantly superior scores than non-drug patients".

It was further hypothesised that while the mean scores for the drug and no-drug groups were indistinguishable, there might be a greater degree of scatter in the scores of the drug group as a result of the contrary influences at work. Standard deviations for each group for each test were calculated, but using Student's t, no significant differences could be identified. This point was examined further with a group of schizophrenics who were tested in a later experiment, and half of whom were receiving medication. The findings are contained in Chapter 6.

IV. Results of the Peg-board Test and their Relationship to Simple Reaction Time.

The object of using a battery of tests rather than a single one is to obtain an adequate cross-section of information about behaviour with the minimum of reduplication. Seashore, Buxton and McCullom (1940),

isolated six factors from a study of twenty-one instrumental motor tests. King (1954) found that his battery was most closely identified with three of these, viz.

(i) "the speed of single reaction" or "the speed of initiating movement;"

(ii) "finger, hand and forearm speed in restricted oscillatory movement" or "speed of stereotyped wrist-arm movement";

(iii) "precision" or "manual and finger dexterity."

This chapter has so far been concerned with the first of these factors as measured by simple R.T. The nature of this task, with the movement component at a minimum, is such that it largely reflects the speed of central processes. In this section, attention will be paid to the peg-board with its emphasis on peripheral motor activity (the "precision" factor above) and to the inter-relationship between these two types of activity. Evidence from a number of sources will be considered showing that performance on these two types of task, the one central, the other mainly peripheral, may alter independently from one another.

Peg-board results.

Since this task involved continuous activity over several minutes, it could reasonably be expected that results would prove relatively stable indicators of age, drugs and diagnostic grouping, but the experimental design adopted did not include these as independent variables. In order to discover whether any reliability may be attached to the results, one may draw on circumstantial evidence.

Firstly, the effects of drugs were examined (see Table 3.17), using a control group, and no significant difference between groups could be established on the first occasion of testing. At this stage patients were either on a minimal degree of prescribed medication, or no medication at all, or on some unknown medication of their own choosing.

Compared with other influences, any effects of drugs appear to have been slight and certainly not heavily loaded on one or another diagnostic category.

The effect of age on psychomotor tasks has been extensively studied by Welford (1958) and his colleagues. In bringing together several pieces of work (e.g. that of Leonard (1953) and Singleton (1954)) he makes it clear that when a distinction is drawn between decision time and movement time in tasks with both components (serial R.T.), older subjects are very much slower on decision times but the movement time is less affected. He concludes "that the main locus of slowing with age in sensori-motor performance lies not in the speed of movement but in the time taken by central processes initiating, shaping and monitoring movement."

With this in mind the data on older patients have been compared with those on younger ones. Recognising that there is a confounding interaction between age and diagnosis (the depressed patients were also the older ones) it is appropriate to compare performances on the third occasion of testing, i.e. when mental state is least important.

Figure 3.16 shows the performances on the peg-board of patients aged 60 and over compared with younger age groups. It is clear that the oldest group is significantly slower than the others even on recovery, and this difference is of the order of 17%.

This may be compared with the difference on simple R.T. between younger and older patients where a much larger discrepancy occurs, of the order of 36%, which is akin to Welford's findings.

A comparison of peg-board speeds for the over 60's on the first and third occasion of testing revealed that there is no significant difference between them ($t = 0.69$). But comparing depressed patients in the same way does reveal a significant improvement from 0.60 to 0.71 pegs per second ($t = 3.63 : P < .01$).

There is, therefore, a case for examining peg-board speeds in relation to diagnostic category and comparing them with normals. The normal group was superior to all patient groups and, while there was a slight improvement over three occasions of testing, this change did not reach statistical significance. The distribution of patients shows essential similarity to that observed with simple R.T. performance, viz. that the psychotic categories are the most severely affected. Interestingly, the manic-depressives and organics function at a much lower level than the schizophrenics. Among the organic patients were those whose lesions involved extrapyramidal dysfunction (e.g. a case of Huntington's chorea) so the low mean level of the organic group is to be expected. The depressive group included a large proportion

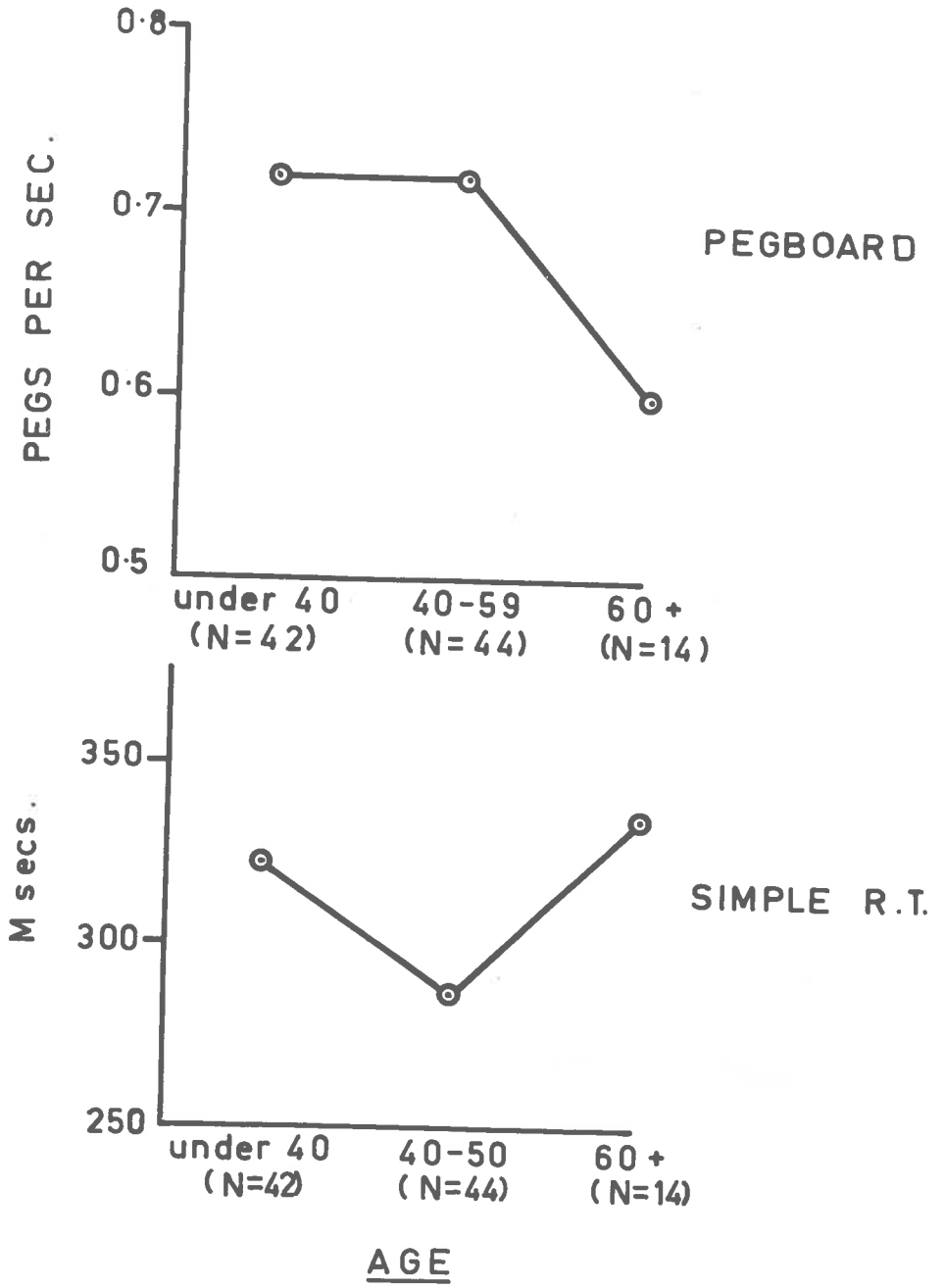


FIG. 3.16. INFLUENCE OF AGE AT THE THIRD OCCASION OF TESTING ON PEGBOARD AND SIMPLE R.T.

who on clinical examination had identifiable psychomotor retardation. The slightly unexpected picture of slow speeds by hypomanics is fairly certainly a function of clumsy impulsivity associated with their elated mood.

There does appear to be a difference between these psychotic groups and the schizophrenics who, when performing on a task of manual dexterity, are less impaired than the other psychotics. While performing more slowly than normals, they are more similar to the neurotic groups. The only other evidence to date which might indicate that the schizophrenic's impairment is severe on simple R.T. but less apparent on peripheral movement measures, is to be gleaned from some of King's (1954) tables. The group most nearly corresponding to the acute schizophrenics of this study would be his "pseudoneurotic schizophrenes" who were significantly slower than normals on simple R.T., while peg-board scores appeared only slightly different (normals 45.6; schizophrenes 43.1).

While the work of Seashore (1951) and King (1954) makes it clear that among normal subjects a task such as the peg-board involving continuous dexterity tests, something distinct from the speed of initiating a response such as in a simple reaction time experiment, it is important to examine what happens among groups showing psychomotor impairment. Do both factors suffer together, or just one? Is there a differential pattern between diagnostic groups?

The correlation between the two tests is shown in Table 3.38 and compared where possible with correlations reported on similar groups elsewhere. It is apparent that where comparisons are possible, the

figures in this study have much in common with other work. This is further confirmation of the reliability of the data obtained in this acute admission context. The neurotic group shows a low positive correlation between tests. Examination shows marked slowing of simple R.T. but the dexterity task is scarcely affected. The organic group includes several patients having motor co-ordination problems. Hence the dexterity score is the lowest of all groups, as well as showing evidence of impaired central processing in the long R.T.s

GROUP	Mean R.T. (trans-formed)	Mean Pegs per sec.	Rank Correlation coefficient	Comparable Work	
1. Normals (44)	-9	0.84	+Q13	King	+0.39
				Seashore	+0.15
2. All Patients (100)	-312	0.68	+0.37	King	+0.35
3. Schizo-phrenics (23)	-353	0.69	+0.61	King	+0.57
				Stotsky	+0.51
4. Depressives (27)	-313	0.64	+0.51		
5. Hypomanics (9)	-425	0.65	+0.25		
6. Organics (8)	-390	0.58	+0.22		
7. Neurotics (14)	-374	0.74	+0.29	King	+0.29
8. Alcoholics (9)	-140	0.65	-0.05		
9. Psychopaths (10)	-124	0.86	+0.66		

Table 3.18 - Relationships between Simple R.T. and peg-board performance.

The psychotic groups show impairment on both types of test. Absolute levels are in part confounded by other variables but it is clear that schizophrenics and depressives both exhibit deficits of central and peripheral processes. The hypomanic group is similarly impaired on both types of process, but here there is only a small positive correlation on the two tasks; this is a function of the extreme level of distractibility which produces slow R.T. with a very wide scatter in performance, whereas the continuing nature of the peg-board task is less affected by fluctuating attention.

Since motivation has been invoked as a factor accounting for the high correlation between scores for the psychopathic group, one must consider a similar explanation for the schizophrenic group. Stotsky (1957) tried to distinguish between a failure in central processes and poor motivation among regressed and remitted schizophrenics. He was not able to make a firm distinction but concluded that the more complex the task, the more evidence there was for a deficit which would not respond to changes in motivation. Payne and Hewlett (1960) using measures of intellectual performance obtained clear evidence that retardation of psychological function is a factor with schizophrenics and depressives and comment: "this factor...is measured by all the speed tests, regardless of their content," Yates (1966) reviewing the literature on thought-disorder in schizophrenics also stresses a deficit in speed of information processing and proposes a theory that "the primary deficit in schizophrenia consists in the abnormally slow rate at which information in the primary channel is processed."

Among the alcoholics, impairment of functioning is more evident on the peg-board task than with simple R.T. This one may relate to poor motor co-ordination and tremor in those who are in the withdrawal phase of alcoholism. By the time they were seen, the central effects had largely subsided, but the peripheral component remains impaired. This would be in line with the findings of Muller et al (1964) who found that, with normal subjects under the influence of alcohol (0.79% mean blood alcohol level), hand steadiness was impaired more than reaction time.

The group of psychopaths and immature personalities shows no loss of efficiency on the peg-board. The slight reduction on simple R.T. is of no significance, since (as shown in Table 3.15) there was no indication of improvement in any of the ten patients. It would therefore appear that psychomotor tests have nothing to offer with this group. The only difference apparent between them and normals is in the higher correlation between the tasks. This is best identified as a motivational deficit, resulting in a greater scatter of scores, and may be taken as a positive example of what King failed to find among schizophrenics - "A motivational or attitudinal factor strong enough to result in the group differences observed in average performance might also be expected to alter the balance of inter-correlations found among such test performance by normal individuals, uncomplicated by behaviour disorders." (1954).

These studies make it clear that the marked deficit observed with the functional psychotic group reflects a primary defect in speed of psychomotor functioning, rather than a lack of motivation.

The relationships expressed in Table 3.18 indicate that:

(1) In normal subjects there is little relationship between performance on the two types of task under discussion;

(2) Among the depressives and schizophrenics there is impairment of both functions consistent with a reduction of eifficiency at both the central and peripheral levels. There is a much greater probability of retardation on one task if it also appears on the other than is the case with normal subjects;

(3) The organic patients were impaired on both types of test but most especially the peg-board, involving manual dexterity. This is a function of the particular disorders included in the group;

(4) The hypomanic patients also show impairment on both types of test, but the low correlation between tests is a function of wide variability in attention level;

(5) Among the non-psychotic groups relationships are more tenuous and, where deficits appear, are probably determined by a complex variety of factors, which in the present context are not susceptible to analysis.

Since so many workers agree that psychomotor deficit is characteristic in mental illness, it is worth comparing the hypotheses presented to explain this. Deficits in R.T. with all major diagnostic groups have been demonstrated, but a bewildering variety of explanations has been put forward to explain them.

Wells and Kelley (1922) state that "the quickness of reaction is a criterion of the immediate attention level. The psychoses show some difference in the regularity with which the general level is maintained".

Klopsteg (1917) examining manic-depressives in both phases rejected the notion that R.T. deficit reflects psychomotor retardation "As similar lengthening is found in excitements, and in other psychotic conditions."

Rodnick and Shakow (1940) concluded from the differences in response observed with irregular as opposed to regular P.I.'s, that R.T. performance is governed by the ability to develop a "set", and by the ability to learn from experience. This conclusion, based on work with chronic schizophrenics, has been more recently upheld by Costa (1962) working with organics who "failed to develop set or appropriate expectancy about the stimulus. They failed also over 180 trials to learn to improve."

The importance of the maintenance of attention has also been stressed by Knehr (1954), though with a less easy turn of phrase - "Variability...represents an increase in the amplitude of fluctuations in readiness which are oscillatory in character."

From a different viewpoint, the importance of attention is referred to by Walters (1964). After reviewing a great deal of E.E.G. data in relation to psychomotor activity, she indicates that "slow R.T. could be due to a disturbance of the reticular system...but the evidence is inconclusive."

Shakow has twice in recent years (1962, 1963) been called upon to summarise his views on the nature of the deficit in schizophrenia. He has stressed the importance of pressure to respond to a stimulus, and demonstrated clearly that when the schizophrenic has voluntary control over his behaviour his response is poorest, but the level of response can be substantially improved by the use of appropriate motivation, e.g. electric shock (Rosenbaum, Grisell and Mackavey 1957). If one deficit more than another should be viewed as the primary one Shakow

concludes it is the inability to develop a major set in a response situation or "actually, this inability to keep a major set may perhaps be the secondary result of a positive characteristic, an underlying trend to establish minor sets, to segmentalise both the external and the internal environments." (1962).

However, other possible explanations have been put forward. For example, some sort of arousal hypothesis seems to be suggested by Huston and Senf (1952) when they observe "In the R.T. experiment, the higher the state of preparation to reaction, the quicker the reaction time." This view is questioned by Karras (1962) who assessed the effects of reinforcement on chronic schizophrenics, and argues from Malmo's work that "under normal resting conditions chronic schizophrenics are for many measures of arousal at the same level as normals." Shakow's (1963) opinion is that schizophrenics are of two types in relation to arousal level, some being in a state of hyporeactivity and others hyper-reactive.

An assertion which can scarcely be challenged is that of Stotsky (1957) who concludes that the impairment of psychomotor functions among schizophrenics is not explainable in terms of a single general factor. This rather nebulous statement receives more careful analysis by Rosenbaum, Grisell and Mackavey (1957) who reach the conclusion that lessened reactivity to the biological stress of increasing age, reduced responsiveness to social demands and inability to control anxiety, are three separate dimensions of deficit to be isolated in performance of schizophrenic patients.

King's (1957) opinion is that "the many and varied contexts in which psychomotor defect may be found among the mentally ill suggest the operation of a broad factor in the production of the disturbances observed....The critical nature of the function would appear to be based on the fact that it represents the channel through which the organisms' readjustment to ever-changing environmental circumstances become apparent to the external observer." While King continues to acknowledge that a number of mechanisms could account for psychomotor deficit, he has also now come out strongly in favour of an arousal hypothesis.

"Whether or not "arousal" theory proves to be a unitary characteristic of the individual and useful as a unifying concept in the study of psychopathology...all may find ultimate expression by a similar basic neural mechanism, such as a gradual 'whittling-down' of the control of integrative-organismic-reactivity to the lower brain centers" (King 1968).

Both hyporeactivity and hyperreactivity have been invoked as explanations for psychomotor deficit in schizophrenics (Shakow 1963, Rosenbaum, Grisell and Mackavey 1957). Indications of hyperarousal may be found in raised muscle action potential as well as elevated anxiety test scores (Runquist and Spence 1959). Raised m.a.p.s. have been reported with both process and reactive schizophrenics (Reynolds 1963) and with reactive though not endogenous depressives (Martin and Rees 1966). Very high anxiety levels are known to be present in acute schizophrenics (Court 1965).

Welford (1968) has discussed the relationship of arousal in

relation to age. He observes that here too there is conflicting evidence as to whether older people are over-or under-aroused. He makes the point that the after-effect of stimulation is an important variable, such after-effects increasing with age. Consequently it may be that older people when in a resting state are in a state of hypo-arousal but "the after-effects of any neural event tend to act as noise in relation to another event following immediately after, blurring the next signal and slowing the next response. Since arousal is essentially a result of chronic general activity in the brain, such after-effects could often simulate increased arousal, especially if they were relatively long-lasting as in older people. Such apparent arousal would however last only so long as signals were being received and action taken; when nothing was happening the brain would be quiet and the subject would appear under-aroused."

In the event of hyperarousal one would then encounter a reduction in the signal-noise ratio, with consequently impaired performance, while with hypo-arousal, subjective signal strength would be reduced with similar results. If the prolonged neural after-effects found with increasing age (Mundy-Castle 1962) also provide a basis for hyperarousal in psychiatric illness, it should be apparent especially in responses following very short P.I.s. One may postulate an interference effect from the warning stimulus affecting responsiveness more than for normal subjects. In the "set index" developed by Rodnick and Shakow (1940) one notes that the major difference between normals and schisophrenics for both irregular and regular P.I. is with short P.I.s, the patients

being proportionately slower. Shakow has consistently related this phenomenon to an inability to develop and maintain an appropriate set and considered it pathognomonic of schizophrenia.

Although this present study has not included regular P.I.s, it is important that all diagnostic groups show substantially the same pattern of response to irregular P.I.s (Fig. 3.17). The psychotic groups show an overall slowing but this is most pronounced in relation to short P.I.s.

Another way of examining the importance of short P.I.s is to see what happens as patients recover. Fig. 3.18 compares the average response time for short P.I.s (1 and 2 secs.) with the average response times for long P.I.s (8 and 16 secs.) for those depressed patients who improved markedly. When their response levels are compared with those of normal subjects it is clear that the greatest change occurs in response to short P.I. They become more able to produce a rapid response on the third occasion after very slow response times on the first occasion. Apparently such patients when ill find the very short interval insufficient to prepare themselves to respond, whereas, when a longer interval elapses their deficit is much less marked.

Level of preparedness to any given stimulus is a function of the probability of its appearance - the longer the interval the subject has waited, the more likely it is that the stimulus will appear.

It does not, however, follow that poor performance which looks the same in level is necessarily the outcome of the same psychological deficit. (See Fig. 3.17). For example, the poor performance by hypomanics

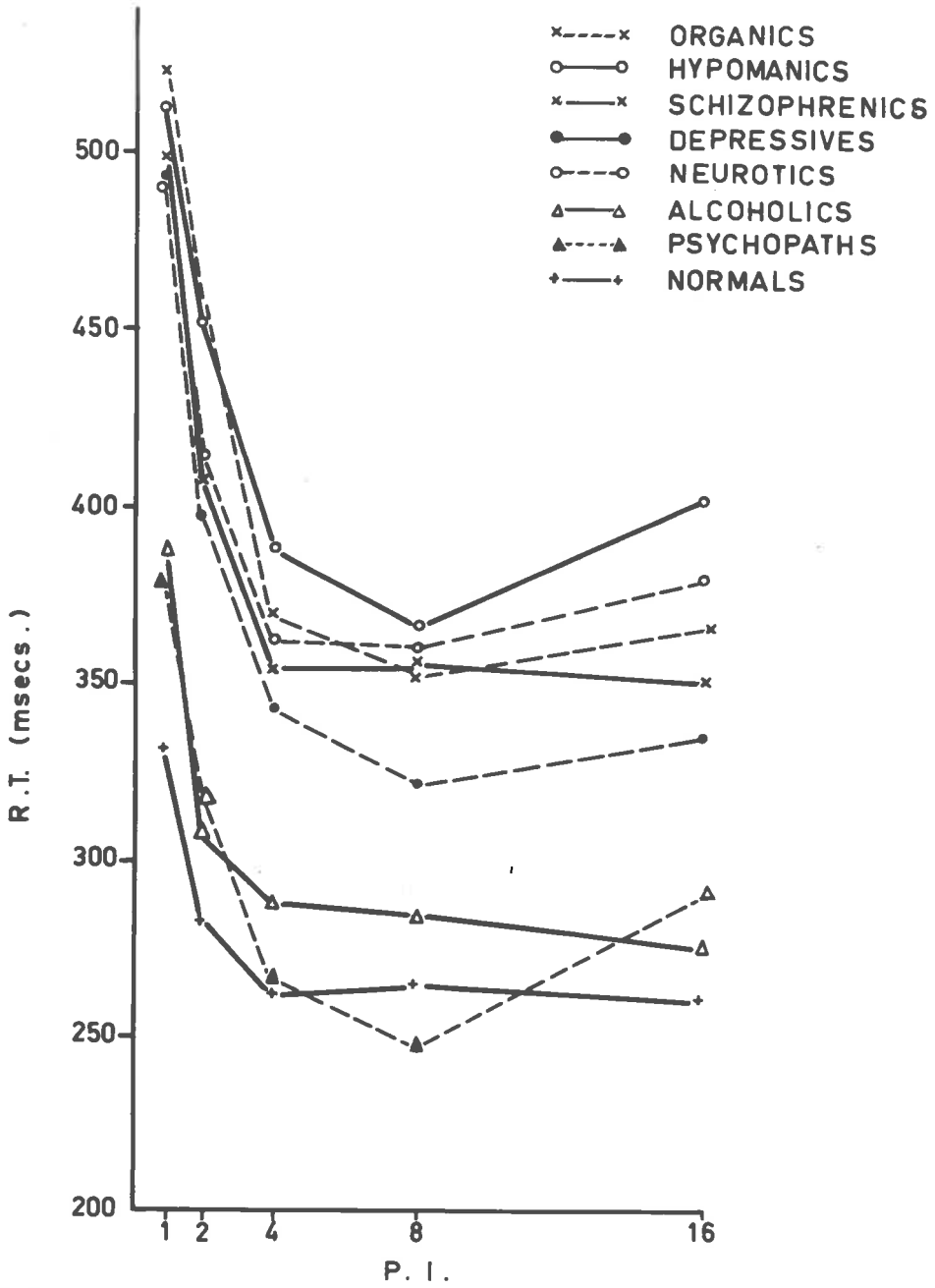


FIG. 3.17. LEVELS OF R.T. PERFORMANCE BY EACH GROUP FOR EACH P.I.

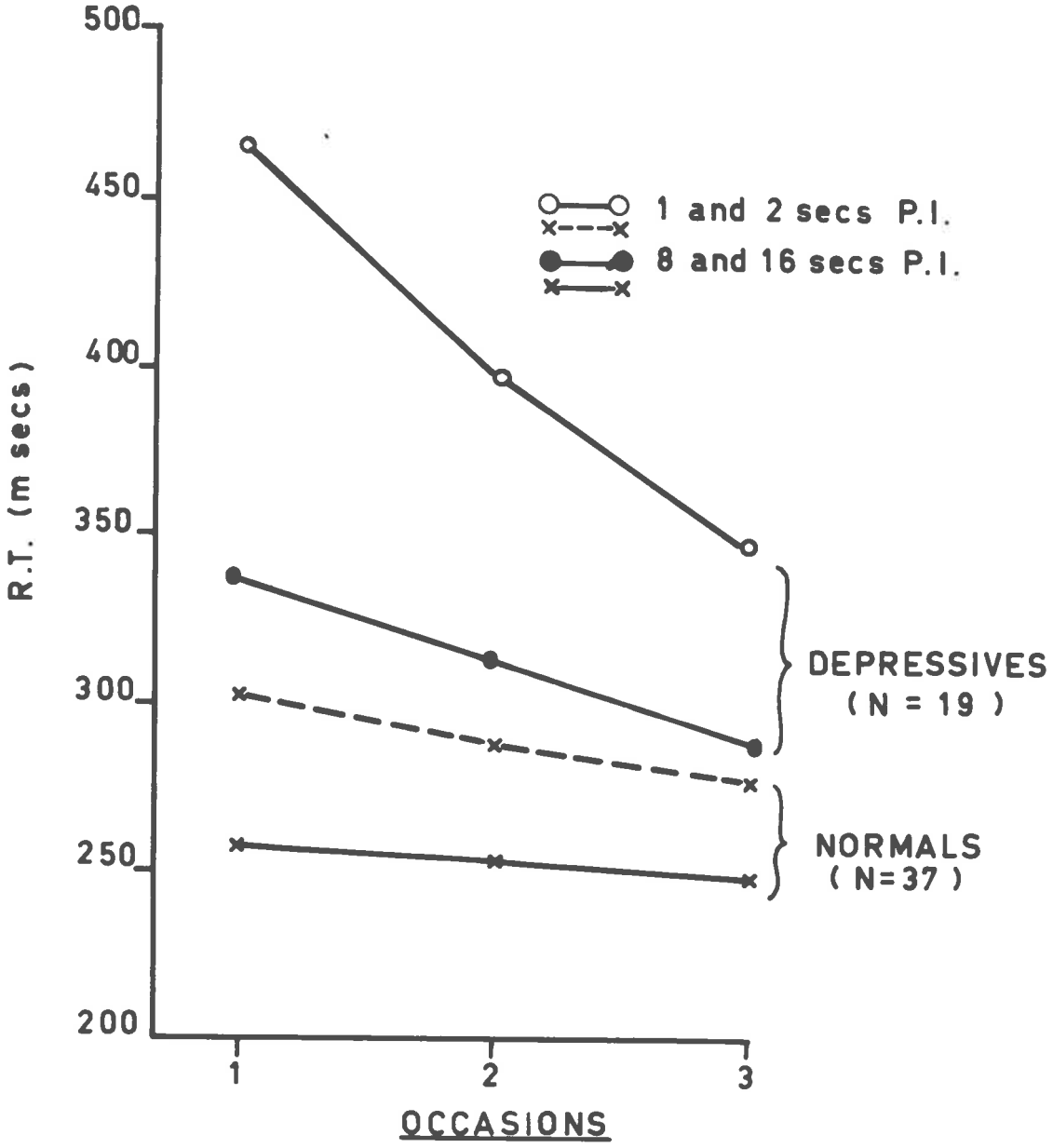


FIG. 3.18. DEPRESSED PATIENTS PSYCHIATRICALLY RATED AS MUCH IMPROVED, AND NORMALS, SHOWING RELATIVE CHANGES ON SHORT AND LONG P.I.

to a P.I. of 16 secs., is fairly certainly due to an inability to maintain a 'set' for that length of time (i.e. an attentional defect); while a similar deficit by the psychopathic group (Fig. 3.17) more probably reflects a motivational defect. On the basis of the similarity of pattern among the groups one would agree with Hall andStride (1954) who were unable to distinguish adequately on the basis of simple R.T. between neurotics, depressions, schizophrenics and post-leucotomies.

In view of the significant changes found to relate to clinical improvement, one is also in accord with Rosenthal, Lawlor, Zahn and Shakow (1960) who relate R.T. performance to "ego-intactness" and quote a correlation of .89 between a reaction time index and ratings of mental health. Zahn et al (1963) comment "the R.T. method gives stable replicable data which bear a close relationship to the presence or absence of schizophrenia and to its <u>degree of severity.</u>"

CHAPTER 4.

CASE STUDIES OF TREATMENT MONITORED BY PSYCHOMOTOR TESTING.

CHAPTER 4.

CASE STUDIES OF TREATMENT MONITORED BY PSYCHOMOTOR TESTING

The demonstration of trends among certain groups of meaningful directions may be of importance, but if it is only possible to consider groups, the results are of academic interest only. It was stressed in the introduction that this study is intended to have a daily practical application. Up to this point, the work reported has been essentially nomothetic in character. Groups have been studied and general patterns of response identified. Clinical psychology is increasingly concerned with the idiographic approach to research, recognising that in the last analysis, clinical responsibility is directed to individuals. Allport (1961) in America and Shapiro (1961) in Great Britain have been among the champions of research focussed on the individual. To do so requires a rather different methodology from the nomothetic approach, and this is still being derived. The semantic differential (Osgood et al, 1957) is a recent development in this direction. It is therefore, worth looking at a few individual records to demonstrate the kind of questions that have been answered using the psychomotor battery.

In addition to testing the majority of patients on three separate occasions, a number were also followed in a more detailed fashion over weeks or months, where it seemed likely that the psychomotor battery could prove of special relevance. The following examples are chosen to illustrate the questions asked by the psychiatrist, and the answers obtained. More detailed independent criteria are reported against which psychomotor results may be evaluated.

First a pair of cases is reported where the relative value of two pharamacological agents was under investigation. Both were young people with behaviour problems and educational difficulties. Both also had temporal lobe abnormalities. Opinion differs on the relative merits of phenobarbitone and amphetamine as an appropriate drug in such cases, since some young people demonstrate paradoxical reactions: Blair (1963) supports phenobarbitone as "particularly effective in grand mal and temporal lobe epilepsy." On the other hand, Sargant and Slater (1956) favour amphetamine in "the behaviour disorders of children associated with abnormalities of the electroencephalogram." Ford (1965) asserts phenobarbitone invariably makes brain-damaged children worse while amphetamine has a quietening influence, "though large doses may be needed." In view of these statements, and especially in view of the potentially addictive properties of amphetamine, it is essential to establish the appropriate medication at the earliest possible opportunity, with emphasis on keeping the dosage as low as possible consistent with therapeutic benefit. Since this work was undertaken, a series of hyperkinetic children who received amphetamine with great benefit has been reported by Levy (1966).

There is also support in the literature (Freed 1962) for the introduction of drugs as an aid with learning difficulties. The use of chlorpromazine is reported, but Freed does not clearly distinguish between it as a direct aid to learning and as a means of reducing response to environmental stress. He favours the view that it "can moderate the effects contributing to emotional conflict;" and this seems likely in view of its tranquillising properties. Amphetamine, however, probably enables a more alert cortex

to operate more effectively in the learning situation in addition to its control of disturbed behaviour. Performance on reading and simple arithmetic has been shown to be enhanced on small doses of amphetamine (Sollman 1957). For the child with educational retardation and behaviour problems, with evidence of E.E.G. abnormality, a good case can be made for the use of amphetamine at least for a limited period of time. Blair (1963) believes that amphetamine enables people to sustain mental effort longer than they otherwise would, so a child should benefit from periods of instruction.

Case 1.

A boy, aged 14, admitted with severe educational retardation (reading age 6 years 8 months) and following a behaviour episode involving the police. He had a history of anoxia associated with circumcision at 6 weeks, and was found on E.E.G. evidence to have marked temporal lobe abnormalities. The psychiatrist in charge wished to know whether any benefit could be derived from either phenobarbitone or Dexedrine. A drug regime was, therefore, arranged so that each drug was tried for one week with blank weeks alternating (save that two consecutive weeks of Dexedrine were tried at different dose-levels). The psychomotor battery was administered at the end of each week, in order to take advantage of any possible cumulative effects. Since this was in part an education problem a weekly assessment was also made of speed and efficiency in reading and arithmetic.

Since this boy's adjustment was not severely disturbed, it was predicted that drug effects would be most clearly demonstrable in speeding or slowing of mean R.T., with perhaps an effect in the other speeded

tasks. Results on the peg-board, OXOX and R.T. are shown in Table 4.1. The speeded tasks are apparently not slowed by phenobarbitone, but the fastest results on both OXOX and the peg-board were achieved during the Dexedrine weeks.

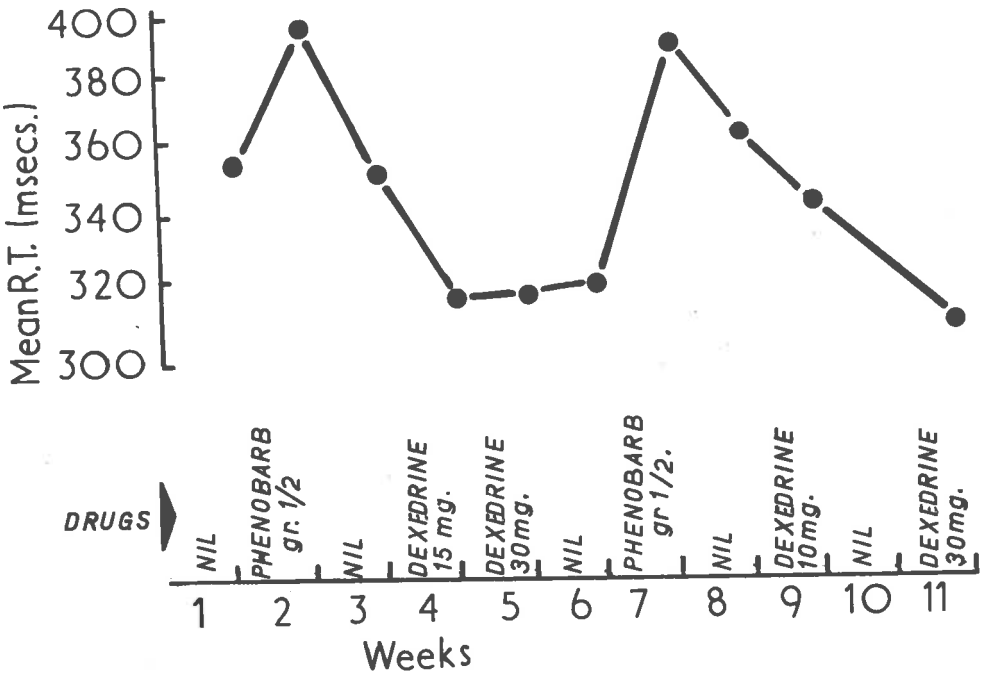
Week	Drugs	Pegs p/sec.	OXOX	Mean R.T.
1.	Nil	0.77	20	35.5
2.	Phenobarb ½	0.71	25	39.5
3.	Nil	0.70	19	35.1
4.	Dexedrine 15	0.82	27	31.8
5.	Dexedrine 30	0.81	27	31.8
6.	Nil	0.83	25	32.1
7.	Phenobarb ½	0.74	24	38.8
8.	Nil	0.79	26	36.1
9.	Dexedrine 10	0.84	25	34.2
10.	Nil	-	-	-
11.	Dexedrine 30	0.83	27	30.8

Table 4.1 - Psychomotor performance during a trial of Phenobarbitone and Dexedrine.

A graphical representation of the R.T. scores (Fig. 4.1) emphasises the following points:-

1. The stable R.T. Level on three occasions when not receiving medication.
2. The slowing of performance on phenobarbitone to the same degree on each occasion.
3. The speeding-up associated with Dexedrine.
4. The finding that a total of 10 mgms.a day had less effect

Fig. 4.1. Simple R.T. levels during a Trial of Phenobarbitone and Dexedrine.



than 15 mg. but that 30 mg. was not appreciably more effective than 15 mg.

5. In a blank week following Dexedrine, an enhanced performance was obtained which could be interpreted as a residual effect of Dexedrine still in the system.

It is of passing interest that at the end of week 2 (phenobarbitone) the nursing impression was of some benefit from the medication. This could well be a 'halo' effect since objective testing indicated the reverse. This underlines the danger of prescribing medications without a means of measuring their effect. The R.T. level at the end of week 9 was slower than expected and at first hard to explain, as it was supposed that the boy was receiving 30 mg. daily. By chance it was revealed by the charge-nurse, who had been on leave until this point, that he had judged 10 mg. t.i.d. to be an error in prescription and administered only 10 mg. daily. Hence after a blank week, the trial was repeated in week 11 with satisfactory results. On the basis of these results, the boy was discharged on a dose of 5 mg. t.i.d. of Dexedrine and attended remedial classes on a day-patient basis.

Case 2

In order to test out the validity of the first case, arrangements were made to follow a comparable procedure with another patient. A girl, aged 7 years 4 months, presented outbursts of uncontrollable temper and very poor school performance. Parental rejection was an evident dynamic factor, but in addition an organic element was suspected. On the Weschler Intelligence Scale for children she obtained a verbal I.Q. of 121, but performance I.Q. of only 80. An E.E.G. was performed with marginal signs of temporal lobe dysrhythmia.

Arrangements were made that following baseline testing of academic and psychomotor performance, she would receive alternate periods on Phenytoin, no medication and Amphetamine 5 mg. b.d. In practice, phenytoin had to be discontinued after only four days as her behaviour became impossible.

Test data were obtained at this point and she then remained

drug free for a further fortnight. There followed a fortnight on amphetamine 5 mg. b.d. Results on simple R.T. are shown in Fig. 4.2 and demonstrate a slowing associated with phenytoin, and improvement on amphetamine.

Due to inability to sleep, her dosage was cut back to 5 mg. and 2.5 mg. and retesting a fortnight later suggested that this level was equally beneficial. In case the trends seen on psychomotor testing to this point were simply due to practice a further drug-free week was requested. Since behaviour did not noticeably deteriorate in the parents' estimation, it is likely, as was postulated with the first case, that a residual effect was exerted throughout the period. (By the start of the drug-free week she had been seven weeks on amphetamine). Consistent with this, the simple R.T. was slower but not as slow as on previous drug-free occasions. With the reinstitution of amphetamine, her simple R.T. level once again improved.

Accounts from both parents and school suggested an improved concentration and retention of material. As a check on this columns of addition and subtraction from the Schonell graded tests were administered on each occasion. For the three occasions without medication, she took an average of 6 mins. 16 secs. to complete the columns and made an average of thirteen errors. On amphetamine, the average time for three occasions was 4 mins. 17 secs. with an average of only eight errors. Clearly her performance was superior with amphetamine. On the one phenytoin testing she made only six errors, but took 7 mins. 15 secs. to finish, reflecting her inefficient cerebration.

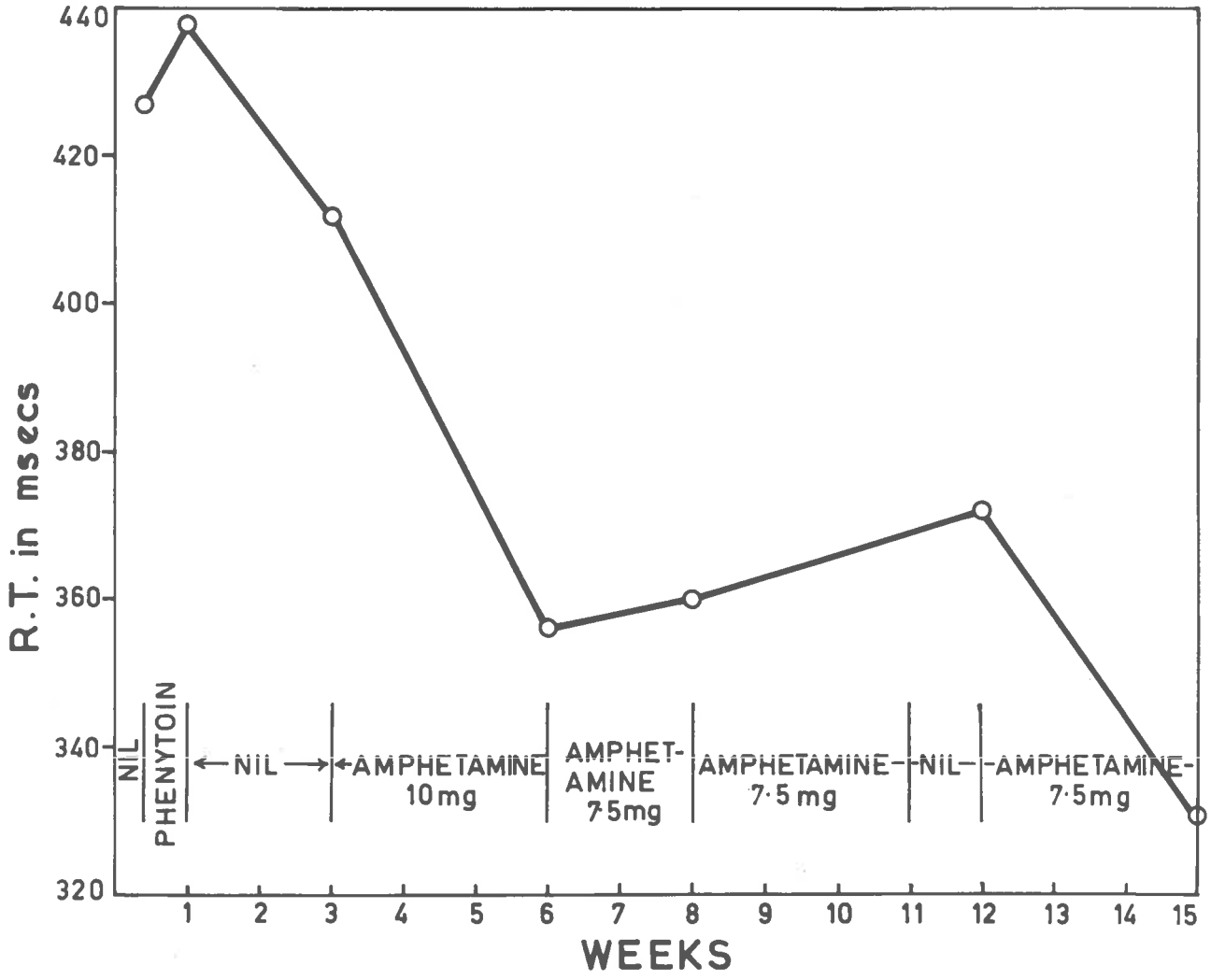


FIG 4.2. RELATIONSHIP BETWEEN MEDICATION AND PSYCHOMOTOR TESTING (SIMPLE R.T.) IN A 7 YEAR OLD CHILD.

Ideally one would have wished in both these cases to have matched the active drug with a placebo in a double-blind design. Unfortunately, with only one patient at a time being tested, it was not possible to mobilise the necessary resources. Fortunately, since these preliminary trials, colleagues have continued the work and have now reported a double-blind cross-over trial using active drug and placebo with 12 children and demonstrated a significant difference on simple R.T. between drug and placebo groups (Cunningham, Pillai and Blachford Rogers 1968). It is concluded that these two cases demonstrate the value of amphetamine in certain behaviour disorders, as well as the contribution that psychological tests can make to the monitoring of treatment.

Case 3

The battery was devised with a particular wish to assess the motor disturbances associated with psychiatric conditions, whether as presenting symptoms seen in neurological cases, or the induced symptoms of drug side-effects.

A case of Huntington's Chorea was, therefore, of special interest. He was a man of 35, characterised by the typical loss of motor control and disorganised memory. He was tested first within a week of being first diagnosed, and then followed periodically over many months. The psychiatrist wishes to find which of two medications would achieve the maximum degree of motor control, and at the same time, whether his intellectual functions were deteriorating.

For this problem one could predict that R.T. would reflect his mental state, while peg-board performance would most readily show changes in motor co-ordination. The results over a period are shown in Table 4.2.

Date	Pegs p/sec.	Mean R.T.	Notes
4/62	0.41	38.5	Diagnosed : no medication
5/62	0.46	38.2	Stelazine
7/62	0.50	-	Haloperidol
11/62	0.44	36.6	Stelazine
12/62	0.44	32.6	"
2/63	0.43	34.1	"
3/63	0.44	30.9	"
5/63	0.39	33.7	"
9/63	0.29	31.9	"

Table 4.2 - Results with a case of Huntington's Chorea followed for eighteen months.

One may conclude from the peg-board performance that the administration of Stelazine proved helpful in controlling his movements, while Haloperidol was even better; but after a plateau of nearly a year there were signs of a loss of control in spite of medication. This can be set against the R.T. Performance which shows in contrast something of an improvement curve. In other words it appeared that he was being held at moderate level for a year after which he was beginning to lose motor co-ordination. This is in accord with clinical comments during that time. Haloperidol was regretfully withdrawn due to the onset of a severe depressive episode, perhaps associated with the medication. Medical opinion was that, apart from this, it was proving more effective than Stelazine.

One other piece of external evidence confirms that these findings give a fair reflection of the course of his condition.

Intellectual functioning was assessed at 4/62, 12/62, and 9/63 and the W.A.I.S. Full I.Q.s were 87, 86 and 79 respectively. While these differences are not significant, they do suggest the onset of intellectual deterioration comparable to that seen in motor functioning.

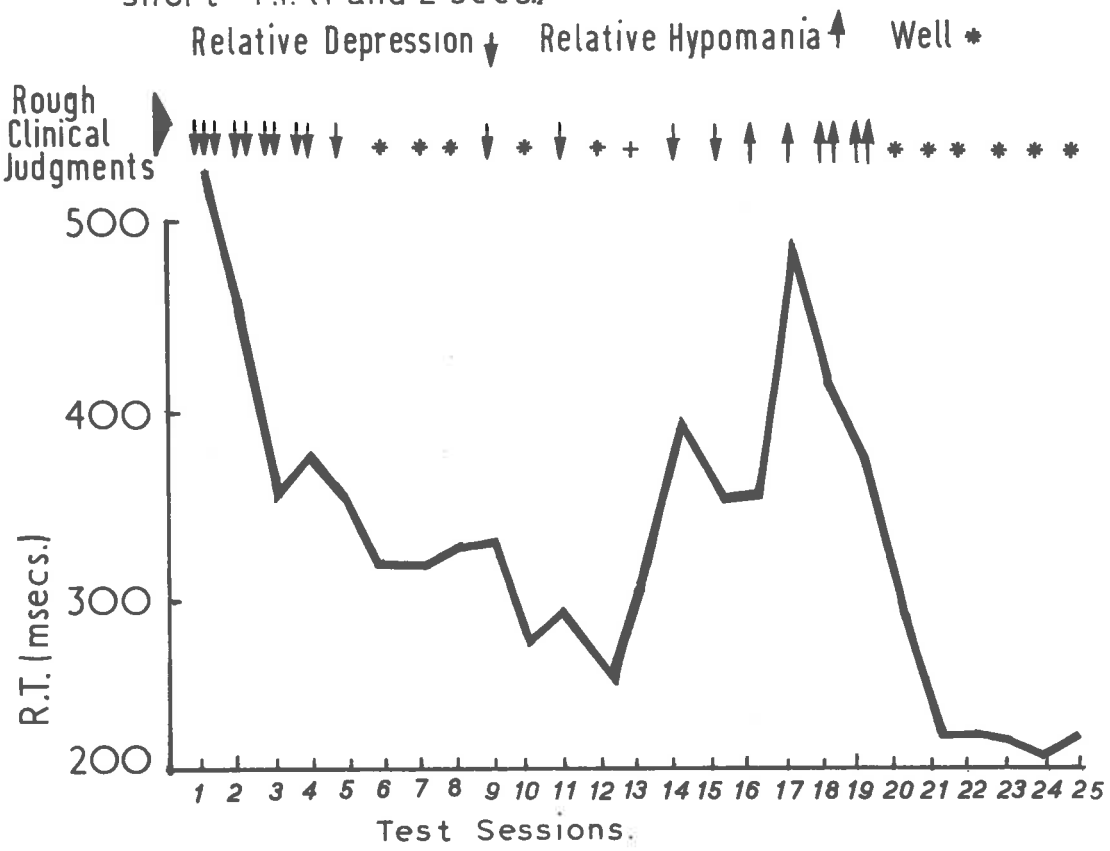
Case 4

A manic-depressive woman, aged 63, known to the hospital through many years in phases of depression and elation was tested at fortnightly intervals over 18 months. After 14 admissions with an average of only 9 weeks out of hospital between admissions, she responded remarkably well to Haloperidol. Since she lived alone and had made suicidal attempts, she was sent out on a maintenance dose and requested to visit weekly. It was hoped that by testing periodically, any recurrence of a psychotic episode would be detected early and thereby treated on an outpatient basis.

It was found that, like many manic-depressives, the clearest indication of a mood-change was a failure to respond rapidly to the short preparatory intervals (P.I. 1 and 2 secs.).

The mean R.T.s to P.I.s of 1 and 2 secs. were plotted and showed a gently decreasing base-line when clinically judged well. This was interrupted by mood swings either way. The testing sequence was started towards the end of a depressive phase. About eleven months later she was judged clinically to be swinging first down then up (See Fig. 4.3). This change was reflected in her R.T. Performance; medication was prescribed on an out-patient basis and she was able to return to a good level without needing admission.

Fig. 4.3 Manic depressive swings related to mean R.T. to short P.I. (1 and 2 secs.)



Case 5

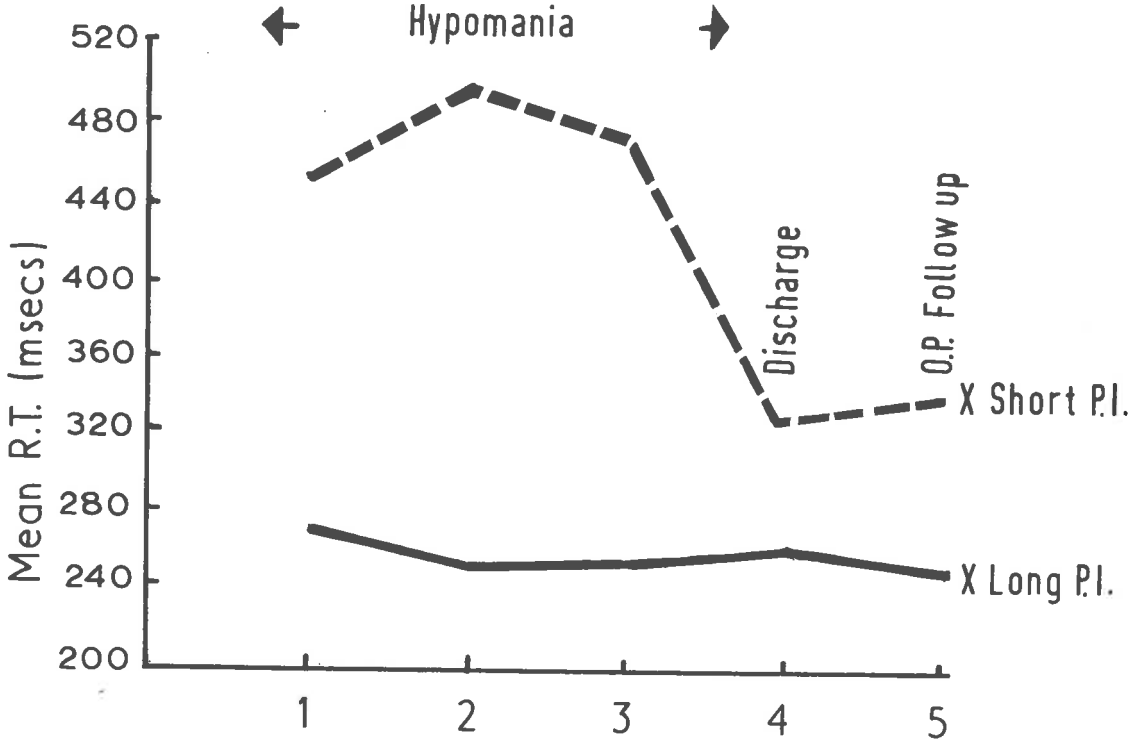
A manic-depressive man, aged 48, who had come to know when he was beginning to move into an elated phase. He was taken in for treatment and did swing into hypomania before responding to Haloperidol. He was seen on three occasions while elated, then twice subsequently when judged to be well. In this case also the R.T. to short P.I.s stood out as being much slower than R.T. to P.I.s of 4, 8, and 16 secs. When he improved the difference between responses to long and short P.I.s was within normal limits, with responses to long P.I.s remaining unchanged throughout. (See Fig. 4.4).

Discussion

Following the examination of simple R.T. Measures with groups of patients, this chapter has been concerned to examine their suitability with individuals. A number of questions of psychiatric importance were asked, and the psychomotor battery was used to provide answers.

The selection of the appropriate drug for behaviour disorders is made difficult by conflicting theories. A purely empirical trial may result in a period of more disturbed behaviour if a wrong choice is made. Conversely, as was found here in Case 1, staff assessing results may give halo responses and accidentally confuse the picture. Simple R.T. provided a most sensitive index of change in two cases showing the value of amphetamine in contrast to a barbiturate. Later reports regarding behaviour and school performance substantiated these early signs.

Fig. 4.4. Comparison of Responses to short and long P.I.s when Hypomanic and Normal.



A similar sensitivity was shown in assessing the treatment of a case of Huntington's chorea and two cases of manic-depressive psychosis. In the former case, the inclusion of the peg-board in the battery was of value in monitoring deteriorating motor function. In the latter cases, an objective check on mood-swings was made so that medication could be adjusted. The observation that short P.I.s suffer more than long P.I.s during illness underlines the importance of including short P.I.s in any response series. The possible significance of this difference has been considered in Chapter 3.

Apart from the incidental remarks by Hall and Stride (1954) on their findings with a few individuals, it would appear that there has not previously been a serious attempt to use psychomotor testing in this longitudinal fashion. Its objectivity and simplicity makes it a most useful technique for monitoring the effects of drug therapy.

CHAPTER 5.

CLINICAL EVALUATION OF 'HALOPERIDOL'

BY

PSYCHOMOTOR TESTS.

I. Introduction

II. Clinical Study

CHAPTER 5.

CLINICAL EVALUATION OF 'HALOPERIDOL' BY PSYCHOMOTOR TESTS.

I. INTRODUCTION.

The advent of modern therapies into psychiatry has brought about dramatic changes in management and prognosis. The major breakthrough with E.C.T. has been followed by a number of significant drug-groups, especially the phenothiazines and the anti-depressants. Still more recently, since 1960, the butyrophenones in the form of Haloperidol (Serenace), Triperidol and Psychoperidol have added further resources in the treatment of psychotic states. All of these agents, while proving therapeutic, have also been characterised by side-effects. These can at times be severe and dangerous and are becoming increasingly well documented.

The side-effects of treatment using the phenothiazines and Haloperidol have attracted attention for two reasons. Firstly, there is one school of thought (e.g. Haase 1964, Danik and Goverdham 1963) which has suggested that therapeutic benefit is more likely to be obtained more readily if extra-pyramidal side-effects appear. This is in contrast to other opinion (e.g. Venning 1963, Svendsen and Willadsen 1963) who view extra-pyramidal signs as an unfortunate side-effect best offset when it occurs, and who lay stress on those patients who recover without evidence of side-effects. That is to say, the significance of extra-pyramidal signs has been a subject of comtroversy.

Secondly, the side-effects can at times be so severe that many of the clinical ways of identifying therapeutic benefit are masked. For example, if a manic patient receives a large intramuscular dose of

Haloperidol, he may develop mask-like faces, motor rigidity and loss of associated movement. One may then wonder if the manic behaviour is being brought under effective control or merely placed in a temporary chemical straightjacket. Without the usual cues of motor activity and facial movement, the therapist can be unsure when to reduce or remove medication. Some way of measuring therapeutic benefit distinct from side-effects would clearly be advantageous.

The phenothiazines have in general a tranquillising effect as well as producing extra-pyramidal signs and for this combination of drug action, the term neuroleptic has been coined. Haloperidol has very little soporific activity, but quite pronounced extra-pyramidal signs are often noted (Venning 1963). Those most commonly observed are motor restlessness, dystonic reactions and pseudo-parkinsonism. Behind all this, therapeutic results can be most impressive among chronic schizophrenics and manics who have failed on other treatments (e.g., Svendsen and Willadsen 1963, Danik and Goverdhan 1963).

More recently psychiatric interest in Haloperidol has been related to its use with behaviour disorders. The most recent report of its use with children (Cunningham, Pillai and Blatchford Rogers 1968) demonstrated the value of the drug in moderating overactive and aggressive behaviour. Psychological measures included the psychomotor battery used as described in Chapter 2 of the present study, and in a double-blind cross-over study the simple R.T. measure differentiated significantly between an active drug and a placebo group.

Interest in the drug since the first published trial appeared (Jacobs 1959) has been reflected in many papers and several international symposia in Milan (1962), Harrogate (1965) and London (1965). The following account of psychomotor testing on patients receiving Haloperidol arises from a study initiated as soon as the drug was introduced into Britain in 1961. Initial results of eighteen months study were first presented at a conference of the Scottish Psychiatric Research Society in Dundee in 1963 and later published (Court and Cameron 1963). The work was then presented by invitation at the symposia held in London and Harrogate (Cameron 1965).

II. Clinical Study

In the present study Haloperidol was used in the treatment of manic-depressive mania and states of schizophrenic excitement, in every case together with an anti-Parkinsonian agent (usually Disipal) to counter the onset of, or to minimise side-effects. No other treatments were used, and the clinical improvement observed is believed to have resulted from Haloperidol and Disipal alone.

The study demonstrates that the two effects of the drug observed clinically, (viz. reduction in excitement and Parkinsonian incapacity), are measurable by means of a battery of psychomotor tests; that the tests will distinguish between these two effects, and make it clear that the intended reduction in psychotic excitement is not achieved by the extra-pyramidal motor incapacity which accompanies it.

The subjects were patients admitted during a period of 18 months to an acute psychiatric unit with mania or schizophrenic excitement

whose disturbance responded to Haloperidol and Disipal alone without other drugs or treatment. The only experimental intrusion into the therapeutic regime consisted of psychomotor testing at various stages.

The ten treatments were given to eight patients (5 men, 3 women) since one man and one woman were readmitted with a further episode during the period under review. Their ages ranged from 22-66 years. Seven were of average intelligence or above, and one registered an I.Q. of 78 on recovery, but dullard level (57) on admission.

Four of the eight patients had unequivocal manic depressive manias, and all had had previous psychotic affective episodes. The other four cases could not properly be called manic-depressive mania. In one way or another they suffered persistent defect over many years (three of them had delusions of persecution or influence of a schizophrenic kind, and one was of low average intelligence, performing at a feeble-minded level on admission). In addition they had all suffered episodic attacks of agitated, restless or elated over-activity, pressure of talk and alteration of mood associated in the deluded cases with a florid expansion of their delusional ideas. It was in such an attack that each of these cases was admitted.

Haloperidol was given in all cases. On nine of the ten occasions the drug was administered parenterally initially. All had it orally at one time or another. By the I.M. route 7½ - 25 mg. daily were given for between 3- 26 days (av. 19 days). The size and duration of I.M. dosage was determined by therapeutic effect achieved and intensity of

motor incapacity. The same therapeutic effect and extrapyramidal disturbance occurred from case to case as the outcome of very different dose and duration schedules. (See Figs. 5.1. and 5.2).

In all cases oral administration followed; in most cases (8 out of 10 treatments) up to and after discharge as a maintenance dose of 1.5 - 5 mg. daily (av. 3 mg.).

Drug Effect

The effect aimed at in giving this drug was primarily to normalise and stabilise the affective disturbance. There were also, however, effects upon schizophrenic symptoms and motor activity which were perhaps unexpected and whose order of appearance holds interest. Parkinsonism occurred, and was the first observable change to occur, in all cases between 3 and 13 days (av. 7.55 days). In this state of apparent motor slowing and loss of associated movement, manic over-activity and delusions were still clearly identifiable. In this state also psychomotor tests were given a second time.

Affective disturbance, though it persisted after the onset of motor slowing, was the first major area of disturbance to clear up, preceding the disappearance of delusions (in the four who had them). An unmistakable affective change occurred clinically between the 5 and 24 days (av. 11.55 days), i.e. when the patient was still in a state of Parkinsonism. Rather curious clinical effects resulted when the patient entered Parkinsonism, but for a few more days remained manic, and one might describe this as mania in slow motion.

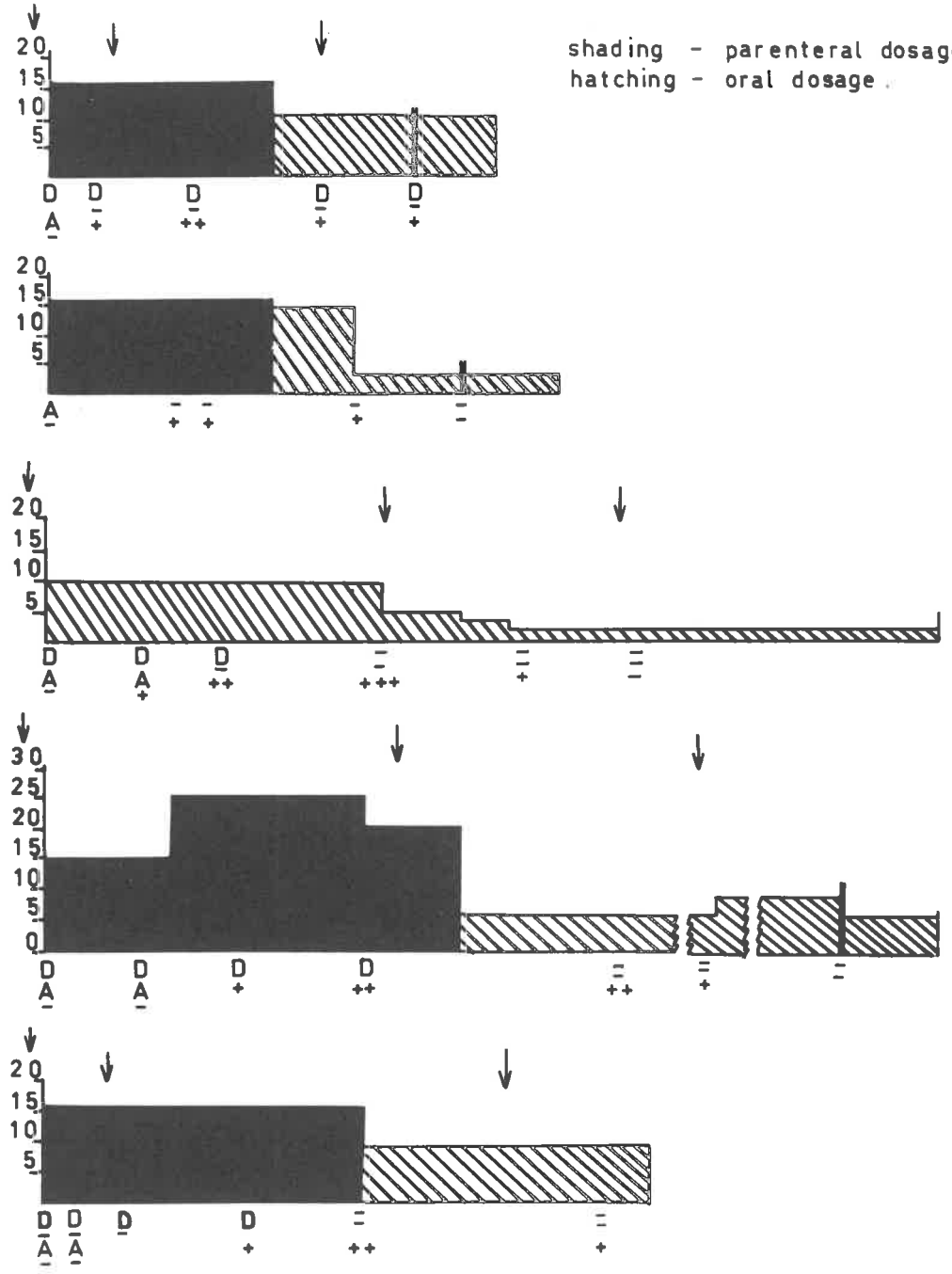
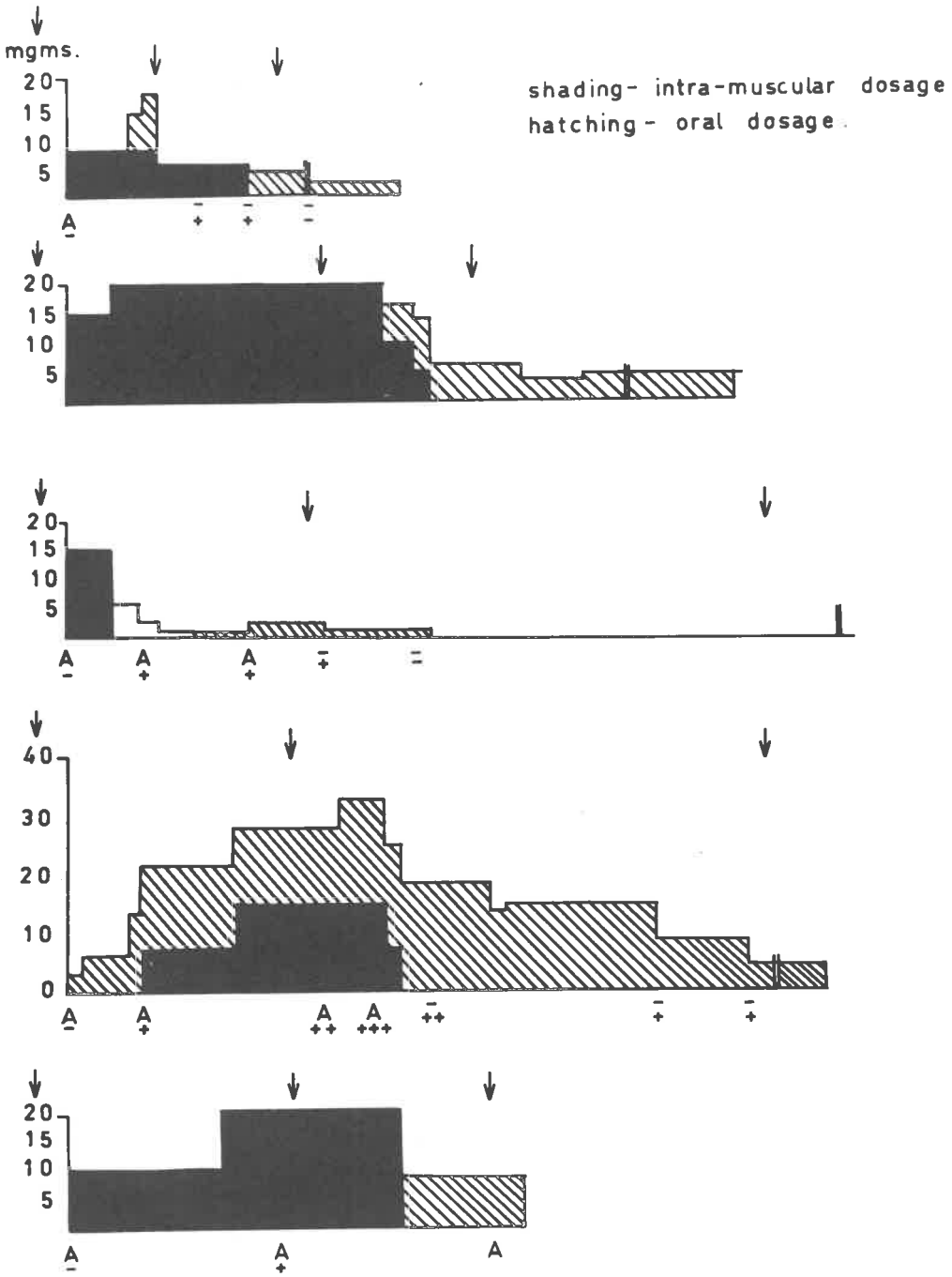


FIG. 5.1. "HALOPERIDOL" REGIMES FOR CASES OF SCHIZOPHRENIC EXCITEMENT



DAYS 2. 4. 6. 8. 10. 12. 14. 16. 18. 20. 22. 24. 26. 28. 30. 32. 36. 38. 40. 42. 44. 46. 48. 50. 52. 54. 56. 58.

A - AFFECT ARROWS REPRESENT PSYCHOMOTOR TESTING - AND + MOTOR DISTURBANCE.

FIG. 5·2 "HALOPERIDOL" REGIMES FOR CASES OF MANIC-DEPRESSIVE MANIA.

Three cases showed delusions of a schizophrenic kind, which cleared up on three occasions out of four when Haloperidol was used, 21-36 days after first administration of the drug (av. 25.66 days) viz. 16.3 days after the affective change.

The same battery of psychomotor tests as used in the study reported in Chapter 3 was administered on three occasions - once on admission, prior to treatment, once during treatment when side-effects were noted and clinical improvement was noted, and once prior to discharge when side-effects were minimal or absent, and clinical improvement was maximal. Results on the final occasion of testing are not completely free of variance attributable to side-effects because some of the group were still on a maintenance dose of Haloperidol at the time of discharge.

Hypotheses

The main hypotheses concerning test results were concerned with the antagonistic effects of improving mental state on the one hand, and extra-pyramidal motor incapacity on the other. It was anticipated that the four tests would be affected in the following way.

(a) The size of writing would decrease as the expansive mood was replaced by a more normal affective level. The appearance of side-effects should produce micrographia, so augmenting the tendency for size of writing to diminish. With the reduction of side-effects towards the end of treatment, the size of writing should therefore increase again, but not as far as the original level.

(b) With the appearance of muscular rigidity, graphomotor speed would be reduced, but improved mental state should result in increased productivity. This was hypothesised with observed behaviour in other disorders in mind. One might have hypothesised that the hypomanic patient might produce a greater output than normals, but a hypothesis of reduced efficiency was favoured.

(c) The same hypotheses should apply to the peg-board task, since this was also a continuing psychomotor activity. There should be a relatively poor level of performance at first, becoming worse as the side-effects exert an influence but mental health is not recovered; followed by an improvement to near-normality on the last occasion.

(d) With the R.T. results, it was hypothesised that the influence of side-effects would be minimal, but the influence of improved mental state maximal. Each occasion should therefore show progressively better results.

Results

Results are broadly in accordance with the hypotheses outlined. In all cases, improvement in mental state was observed independently of the psychological findings; in all cases also, side-effects were observed. Fig. 5.3 shows the trends for each of the four tests. The expected direction of change with mental improvement for each test is down, while the expected directions due to side-effects are indicated on each figure. In spite of antagonistic effects operating on three of the tests,

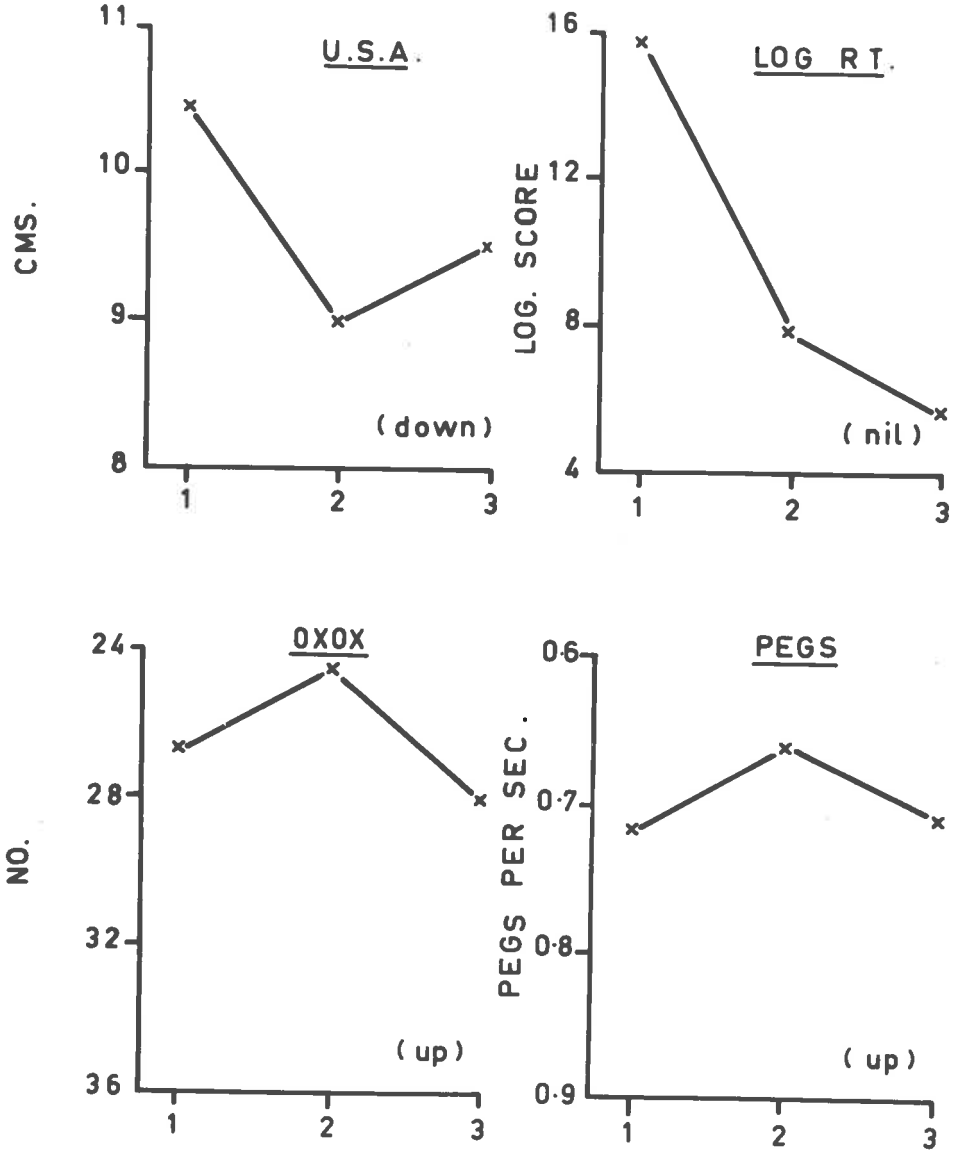


FIG 5·3 CHANGES IN PSYCHOMOTOR PERFORMANCE UNDER HALOPERIDOL. NOTE - EXPECTED DIRECTION WITH IMPROVEMENT IN MENTAL STATE IS DOWN IN ALL CASES EXPECTED DIRECTION DUE TO SIDE EFFECTS IS SHOWN AGAINST EACH FIGURE.

significant differences between scores were obtained for each. (See Table 5.1).

	Comparing 1st & 2nd occasion t (1-tailed)	Comparing 2nd & 3rd occasion t (1-tailed)
Size of writing (U.S.A.)	2.96*	1.81
Speed of writing (OXOX)	1.41	5.19*
Peg-board	3.08*	3.95*
Simple R.T.	2.21*	1.48

* $p < .05$

Table 5.1 - Comparison of psychomotor results for each occasion of testing.

The results indicate that it is possible with these tests to determine independently the relative trends towards mental improvement and physical side-effects. A similar approach has been reported by Brooks and Weaver (1961) assessing the effects of Trifluoperazine on chronic schizophrenics. They too remark on the differential sensitivity of the psychomotor tests used. Nothing of this sort has been reported with acute patients hitherto. The results support the claim that the drug is not having simply a sedative effect. Performance on simple R.T. is enhanced with continued administration of the drug rather than reduced as would be the case with a drug which simply sedates (Huston and Senf 1952). They also suggest that the hypomanic individual is not quicker and more alert than others as might be supposed from superficial observation; rather, a clear loss of efficiency is detected

CHAPTER 6.

AN EXPERIMENT WITH SCHIZOPHRENICS INVOLVING LEVELS OF COMPLEXITY ON A REACTION-TIME TASK.

CHAPTER 6.

AN EXPERIMENT WITH SCHIZOPHRENICS INVOLVING LEVELS OF COMPLEXITY ON A REACTION-TIME TASK.

The following experiment was conducted specifically to explore the relevance of psychomotor studies in calculating certain hypotheses relating to the basis of thought-disorder in schizophrenics.

Interest continues to be aroused by the nature of the deficits exhibited in schizophrenic reactions, sonce so few leads have as yet proved rewarding. Numerous hypotheses have been proposed to account for the aetiology, but no theory has proved entirely satisfactory. It seems likely that multiple explanations need to be invoked since it is now clear that the disorders embraced under the heading of schizophrenia do not constitute a single diagnostic entity.

Since the diagnostic label of schizophrenia is used in relation to a heterogeneous population of patients any theoretical investigation using this as one of the experimental variables is open to criticism. For the purpose of communication with practising psychiatrists and in purely practical contexts (as in the earlier chapters) the conventional categories can be justified. For this theoretical investigation the particular facet of thought-disorder has been adopted as a required symptom in the schizophrenic syndrome. The hypothesis put forward by Yates (1966) as an alternative to that proposed by Chapman and McGhie (1964) is under consideration.

The core of Yates' proposition is that "the primary deficit in schizophrenia consists in the abnormally slow rate at which information in the primary channel is processed." This he distinguishes from Chapman and McGhie's theory "largely in that they stress the importance of the over-loading of the short-term memory system with irrelevant stimulation which is not screened out....It is here argued that the basic difficulty is an inability to process relevant information which is, for the schizophrenic, often presented at a rate faster than his primary processing channel can handle. Second, the present theory stresses the importance of pressure to respond." (op. cit.p.107).

In support of their theoretical positions, Yates on the one hand and Chapman and McGhie on the other both invoke information theory concepts and relate their ideas to Broadbent's filter theory. Yates assumes that the total information processed, whether relevant or irrelevant, overloads the processing system because of its inefficiency. Chapman and McGhie emphasise that it is when irrelevant material is introduced that breakdown occurs (McGhie, Chapman and Lawson, 1965.). Thus while Yates would accept the importance of Chapman and McGhie's work, it is with the proviso that a simpler explanation than theirs for the deficit is possible, viz. that the central problem is the amount of information to be processed.

As a corollary to his main proposition Yates further asserts that short-term memory processes are crucially involved, and that schizophrenic deficit will occur when there is pressure to respond. The evidence from a perceptual study by Harwood and Naylor (1963) is in line with Yates' conclusions. With tasks of increasing complexity, psychotics deteriorated in perceptual assimilation more rapidly than

did normals. The perceptual tasks included unitary perception and the integration of several perceptual elements. It was found that with the simultaneous perception of more than one element, the difference in speed of performance between patients and normals increased as the number of elements was increased up to five. The authors identify the deficit as "more closely associated with decrease in rate of perceptual integration than with decrease in capacity to memorise and infer." Whether this study provides evidence for a theory of schizophrenia is open to question since of the 30 patients tested, only 21 were diagnosed schizophrenic. Payne (1960) too has argued that the deficit found in recalled material could be due to inadequate perception rather than failure in short-term memory storage.

Venables (1958) examined the effect of stimulus complexity with a small group of chronic schizophrenics and found a linear deterioration. This is in contrast to Harwood and Naylor's findings and contrary to predictions from Yates' theory. However, Venables' study used only eight chronic schizophrenics and no distinction was made between types of schizophrenia.

A study by Karras (1967) was designed "to determine if the slower performance of schizophrenics is due to slower data processing." The point is made that current studies "confound short-term memory

storage with processing rate", so a reaction time task was used to permit the investigation of response selection not involving short-term memory storage. Unfortunately, a number of features of the experiment as described make it difficult to draw firm conclusions for or against the initial hypothesis. Choice of subjects, design and procedure have all been criticisedelsewhere (Court, 1967, see Appendix V).

King's (1954) work offers a number of useful leads. In measuring speed of reaction time, four different measures were taken, described as lift reaction time (R.T.L.), jump reaction time (R.T.J.), disjunctive lift reaction time (D.R.T.L.) and disjunctive jump reaction time (D.R.T.J.). The first two measures constitute the decision and movement times of a simple reaction task, while the other two are the equivalent measures for a choice reaction involving a left or right discrimination. The frequency distributions of response times for normals and chronic schizophrenics for all four measures were rather similar. They proved to be slowed in both decision and movement times to a comparable degree (correlation R.T.L. and R.T.J.= +0.93).

The question whether the discrimination element played a more significant part with the schizophrenics than the normals was also examined and the conclusion reached that "the defect present appears to reach each type of response in proportionately equal amounts."

This conclusion does nothing to support or deny Yates' hypothesis that the amount of information input is a crucial variable, since it is clear that insufficient complexity of task is involved. The

present experiment was devised to incorporate a greater degree of task complexity by requiring responses in 2, 4 and 8 choice situations. If task complexity is alone sufficient to cause a breakdown in performance of schizophrenics, then the slope of deterioration with increasing complexity should be sharper than that for normals. Plotted against the number of choices, the slope of the psychotics would be non-linear while the normals could be expected to show a linear deterioration.

The present experiment is concerned with essentially the same situation as that described by Karras (1967) and Venables (1958), but an attempt has been made to avoid the ambiguities apparent in the Karras study. Care has been taken over selection of subjects to ensure that chronic hospitalisation does not confound the issue, and that more precise classification is possible.

Experiment

A group of 24 patients was compared with a matched group of 24 normals subjects. The patient group was obtained through contact with several psychiatric colleagues according to the following criteria:

(a) diagnosis of schizophrenia;

(b) the clinically identifiable presence of thought-disorder at the time of referral;

(c) the illness should be either of recent onset or a recent exacerbation following adjustment in the community;

(d) medication was noted if given, or withheld until testing had been completed if not previously initiated;

(e) no patient of 45 years or older should be included;

(f) patients could be in, out or day-patients.

The normal subjects were obtained from hospital staff, students and acquaintances and matched for sex and age to within two years. No account was taken of intelligence as a matching variable both because of the previously reported work of Tizard and Venables (1956), Rosenthal, Lawlor, Zahn and Shakow (1960) and the more recent findings of Harwood and Naylor (1963), that in a rather comparable context, correlations of their results with W.A.I.S. I.Q.s "were of the order of zero." Since this study was planned it has been suggested on theoretical grounds (Eysenck 1967) that simple R.T. should not correlate with intelligence, but choice R.T. involving increasing information should correlate negatively. The work of Roth (1964) is reported as exploring this specifically and finding the predicted relationship.

No attempt was made to match for intelligence, but in view of these papers this variable must be considered. The normal control group was largely drawn from professional colleagues so an above average level of intelligence may be safely assumed. There is no reason to suppose any such bias in the patient group. If a differential effect were at work, it would therefore be to make the control group faster on the more complex tasks than a control group of average intelligence. This would make the likelihood of a separation between normals and patients greater. It would have operated in the same direction as that hypothesised for the effect of a breakdown in information processing among the patient group. It would not have a

contrary effect thereby masking the main effect, so the results are not confounded by intellectual differences.

It is to be noted that in asserting simple R.T. is not correlated with intelligence this in no way conflicts with the main proposition of this study that simple R.T. does correlate with mental state. Although intelligence is one aspect of mental functioning, the term mental state as used here is intended to relate to the psychiatric meaning of the term, i.e. relating to the presence or absence of mental illness, regardless of whether intellectual functions may be affected.

Further details are needed to clarify the nature of the experimental group. Within the classification of schizophrenia, six were diagnosed as paranoid, and 18 as non-paranoid. This distinction appears to be of theoretical significance in studies such as this (Payne and Hewlett 1960). Most of the group had been hospitalised for less than one week. Six were still in the out-patient or general hospital context; five were attending a day hospital; thirteen were in-patients of a psychiatric hospital. Of these thirteen, nine had had previous admissions. Exactly half the group was receiving psychotropic drugs of one type or another. Initially it had been hoped to collect an entirely drug-free group but to achieve this in adequate numbers is almost impossible these days. This division between those on drugs and a drug-free group has been taken as an opportunity to compare the performance under both conditions as a subsidiary part of the experiment. Full details concerning the nature of the group are listed in Appendix III.

The selection of an age group cut-off at 45 years was with the intention of reducing variance due to age, especially in relation to movement times (Singleton 1954) and to ensure that the sample should include as many acute patients as possible.

The experimental procedure consisted of four parts. All patients were first asked to complete the first six of Gorham's Proverbs (Form I) to provide some indication of thought processes. To have carried out a thorough exploration of all possible manifestations of thought disorder would not have justified itself in relation to the information being sought, so for the purpose of selection the psychiatric identification of thought disorder was regarded as sufficient and necessary for inclusion in the group. Two of the patients did not complete the proverbs due to language difficulties. The controls were not asked to carry out this part of the test procedure as their thought processes were assumed to be adequate even though degrees of thought-disorder have been demonstrated in normal subjects (Lovibond, 1966). For the patient group, the writing situation served an additional purpose in that co-operation was established before proceeding further.

The second stage consisted of a simple R.T. situation to a regularly appearing light after P.I.s of two seconds. The warning signal was a light immediately in front of the subject. The subject was instructed to press a central button down until a red light appeared and then extinguish it by pressing a key immediately in front

of the light. The light chosen was one of eight later to be used in the choice R.T. situation (see Fig. 6.1). Each subject was told that only the one light would appear and he should press the key as quickly as possible. With all but three subjects the right hand was preferred, so a light in the half-right position was selected as the stimulus (to depress the key required a movement of 3 inches). The three left-handed subjects responded to the light in the corresponding position on the left.

All subjects practised responding until they had mastered the recognised task and felt familiar with the situation. A simple response to 24 stimuli was then obtained and recorded to the nearest 1/100th of a second. Two counters were used so that total times and decision times were obtained separately, and movement times were computed as different scores. (see Fig. 6.2).

The choice R.T. situation followed. Each subject was instructed to respond to whichever light appeared and was told whether it would be one of 2, 4, or 8 lights. The order of presentation of these choices was varied so that 4 patients and 4 controls were presented with each of the six possible combinations of choices (2, 4, 8; 8, 4, 2; 4, 2, 8; etc.). For each choice situation, 24 responses were required. In the 2-choice situation an equal number of responses was made to either light but the order was randomised (the same order for all subjects). Similarly in the 4 and 8 choice situation, each light was presented equally often but randomly. Subjects were instructed to respond as quickly as possible.

Fig. 6.1 - Complex R.T. apparatus showing eight-choice keyboard.

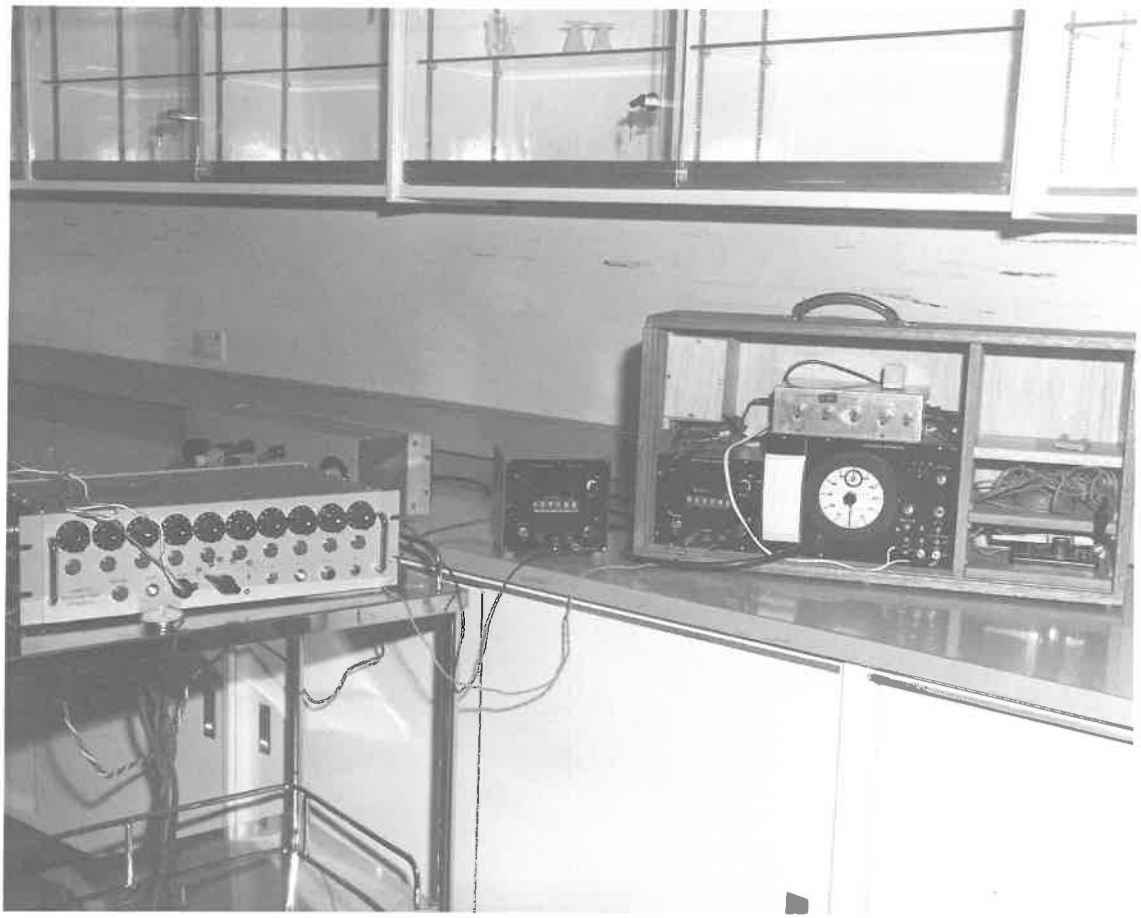


Fig. 6.2 - Complex R.T. apparatus, including twin timers.

The final test sequence involved a repetition of the simple R.T. situation, but with irregular preparatory intervals in place of the regular 2-second P.I. used initially. The results of this series were not intended to bear on the hypothesis outlined above, but to provide a reference point with the results reported in Chapter 2. Consequently, only 20 responses were made in this last series and the distribution of P.I.s was as before (see page27), with one exception, viz. that the longest P.I. used was 12 seconds rather than 16 seconds. This change was made since mean values of scores for 12 seconds and 16 seconds are little different but the occasional disturbed patient was previously found to release the key on very long P.I.s. It is clear from the results to be reported that this change made little if any difference to the values obtained.

Apparatus

The apparatus consisted of a complex reaction timer linked to a keyboard containing eight keys and corresponding red lights (see Fig. 6.1). In the centre of the keyboard was a button which the S. pressed down in response to a small flash of light which served as the warning stimulus. The eight keys were placed symmetrically either side of the central key at distances which involved the subject in movements of

¾", 1½", 3" and 6" in order to depress them. The key and light used for the simple R.T. situation were at a distance of 3" (on the right with right-handed subjects). With the 2-choice situation the two keys either side both 3" away were used. When 4 keys were involved the outer pair on either side served to maximise the movement component (i.e. 3" and 6" either side), while for the 8-choice situation all keys were used.

Response times were measured using two high-speed counters, correct to .01 secs. (see Fig. 6.2). In order to operate the whole apparatus, it was necessary for one person to present the stimuli, while an assistant recorded response times.

Results

For statistical purposes, all reaction times were transformed into log scores in order to normalise distributions and to reduce heterogeneity of variance (cf. Church 1962, Hermelin and Venables 1964, Karras 1967). Figures in the following tables are therefore log values, except where indicated, but for ease of interpretation in relation to results in other chapters and reported elsewhere, raw scores have been used for graphical presentation. Data relevant to the main hypothesis will be considered first, then other subsidiary findings. Since the principal concern is with speed of information processing, the decision time component has been kept separate from movement times, and each examined separately.

		Simple R.T.	CHOICE R.T.		
			2	4	8
PSYCHOTROPIC DRUG GROUP (N=12)	Mean	602.5	658.1	681.7	712.4
		213.5	167.4	159.4	161.9
DRUG FREE GROUP (N=12)	Mean	538.5	630.3	648.8	665.1
	S.D.	116.8	99.3	110.9	88.5
		3.34(<.05)	2.84(<.05)	2.06(N.S.)	3.34(<.05)

Table 6.2 - Comparison of decision times (log scores) for patients on drugs and drug-free.

Using t, no significant differences were found between means on any of these test situations, but a comparison of variances shows that they were significantly greater for three of the four situations with the medication group. In general it would be the more disturbed patients who were on drugs when tested and since it is known that reaction time performance correlates highly with severity of illness, the most satisfactory explanation for the above finding is that the drugs were proving therapeutic to the point that the medication group were no worse on average than the drug-free group. The greater variance can be attributed to the two contrary influences presented in the group, greater severity of illness making for slower scores and response to medication making for faster scores. A comparable lack of significance between means for the drug and no-drug groups was also noted in Chapter 3.

Conclusions

These data relate the effect of increasing complexity in a perceptual situation presented to schizophrenics and normals. In interpreting their significance, it should be noted that there was a pause of several seconds between each stimulus-response sequence, so that the task is properly described as complex R.T. but not sequential R.T. Karras (1967) in his simple and 2-choice situation used an interval between one response and the next stimulus of 8 secs. so that it is inappropriate to describe it as either complex or sequential. The study of Harwood and Naylor (1963) on the other hand did involve a number of degrees of complexity and involved a pressure to respond.

Main Findings

The curve that was obtained is shown in Fig. 6.3. For both groups it is clear that the move from simple R.T. to two-choice R.T. produces a very marked increase in time required for information processing (the decision time component) and lesser increases occur thereafter. While the base level of the two groups is highly significantly different there is little difference in the effect of increasing complexity. The difference between simple and 8-choice reaction (using raw scores) involves a 31% slowing for normals and 26% for the schizophrenics. This difference is small and in the opposite direction to that required by the hypothesis. It follows the same trend as the flattening noted by Karras (1967) If log values are used the difference is slightly greater (25% and 17%) and again the deterioration is less pronounced with the schizophrenic group.

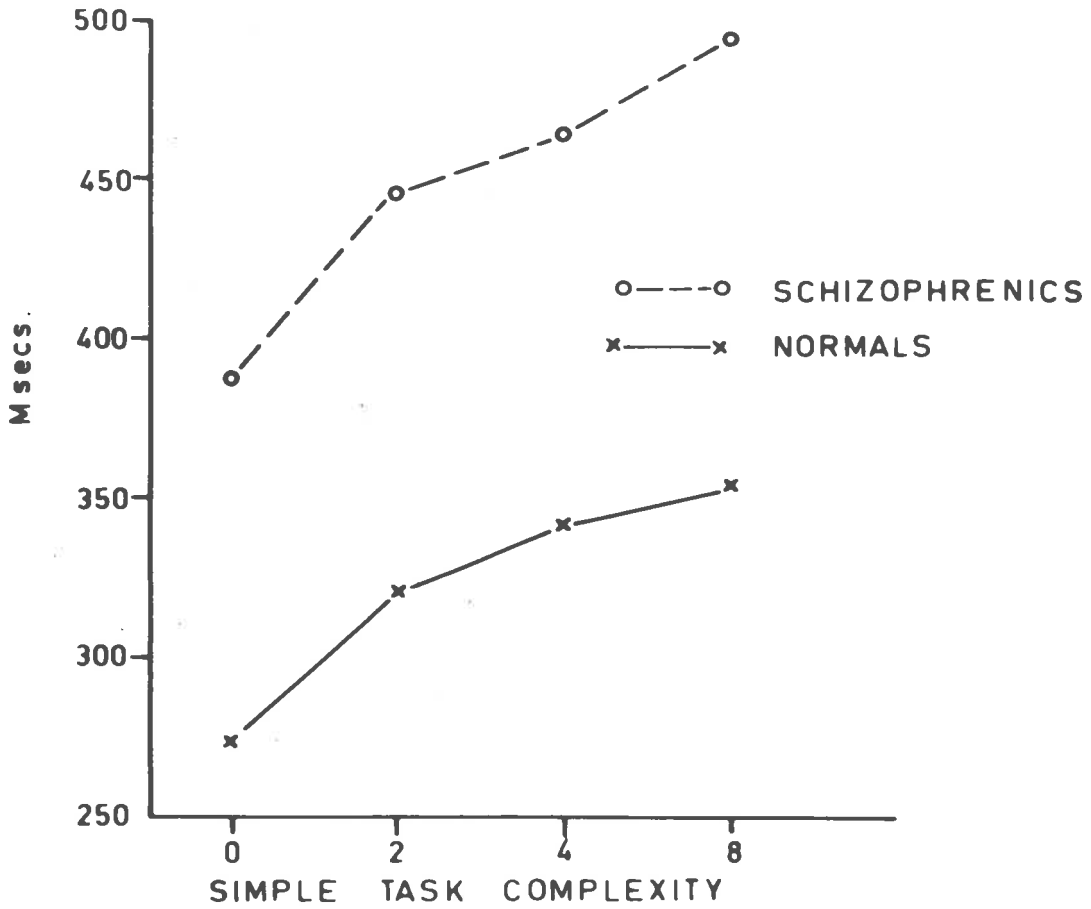


Fig 6 3 THE EFFECTS OF INCREASING TASK COMPLEXITY (VISUAL R.T.) ON SCHIZOPHRENICS AND NORMALS

Both trends were tested for linearity and found not to depart significantly from this.

Paranoids vs. non-paranoids

Before the data in Fig. 6.3 can be accepted firmly, a number of related questions must first be examined. It was noted that the schizophrenic group included some who were diagnosed as paranoid whereas the remainder although showing evidence of thought disorder were not so diagnosed. It is appropriate to examine whether there is any difference between these groups, since Yates proposed that his theory would be more likely to apply to the non-paranoid group. The mean log scores for the two groups are contained in Fig. 6.4. The trends are essentially similar for both groups though the overall level of performance for paranoids is better than for the non-paranoid group. There is no evidence here of an effect in one group being masked by a contrary effect in the other, so the general conclusion that there is no significant difference in trends between normals and schizophrenics remains good.

Drugs

The problem of institutionalisation confounding chronicity was avoided by selecting only patients who were outpatients, recent admissions or re-admissions. But the administration of drugs might be expected a priori to have changed the performance of thought-disordered patients towards a more normal level. A comparison between these patients on psychotropic drugs with the remainder was therefore made. The results for decision times for the two groups are shown in Table 6.2.

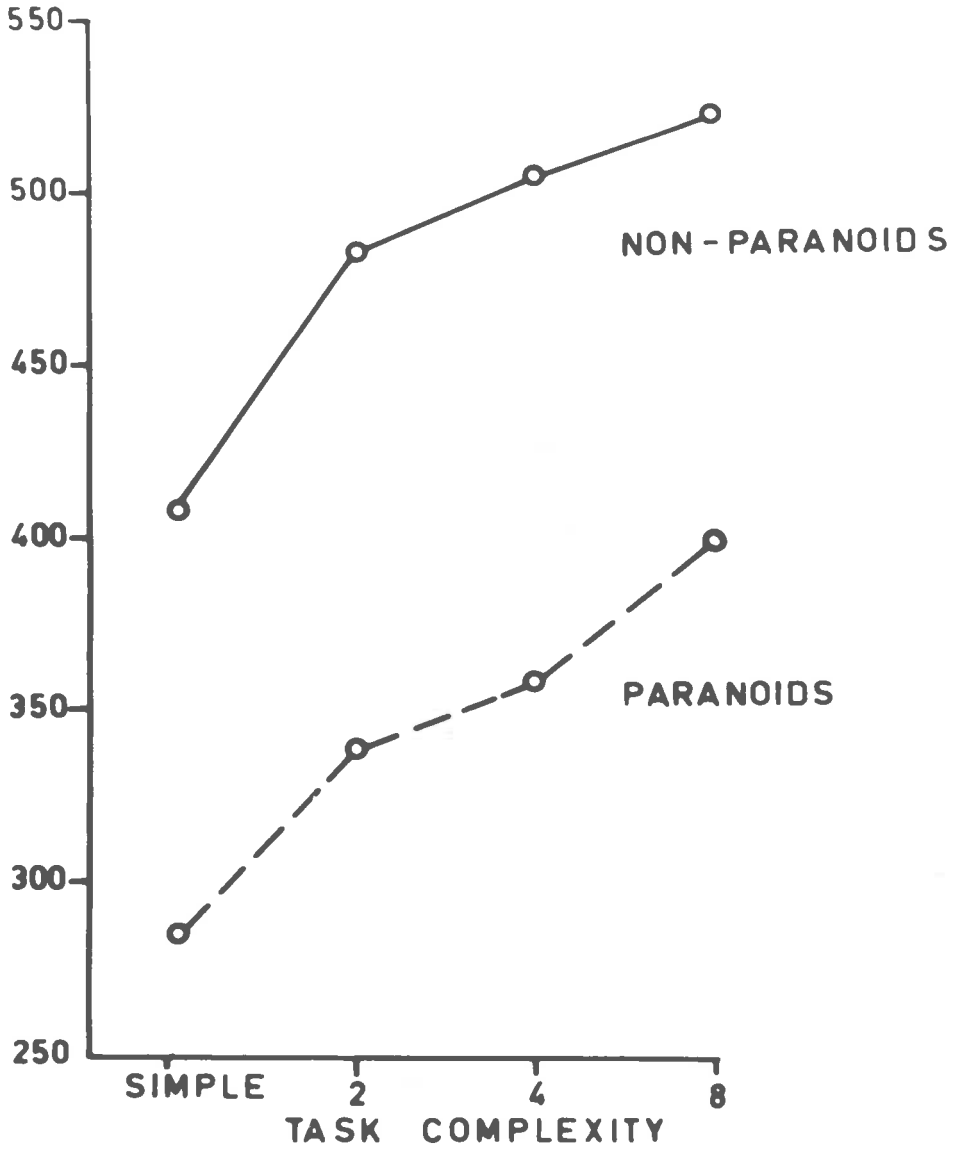


Fig 6.4 THE EFFECTS OF INCREASING TASK COMPLEXITY (VISUAL R.T) ON PARANOIDS AND NON-PARANOIDS.

The present study fulfils Yates' criteria of increasing degrees of complexity and a pressure to respond. The results are closely similar to Venables (1958) findings using eight lights and a verbal response, in that a linear deterioration of performance occurs.

It is concluded that this study demonstrates that increasing complexity and pressure to respond are not sufficient to produce the type of deterioration required by Yates' theory. While the work of Venables (1958) and Karras (1967) have pointed in the same direction, the present study has defined the patient population more rigorously, especially in relation to the important distinction between paranoid and other forms of schizophrenia. In addition, the presence of thought-disorder was required since Yates' theory is concerned with this aspect of schizophrenic functioning. Finally, the experimental group differs from others in being an acute population with active psychotic signs still apparent.

Subsidiary findings

The three types of R.T. situation were analysed separately to determine what were the significant variables, i.e. simple R.T., choice R.T. (2, 4, and 8 choices), and regular P.I. and simple R.T. with irregular P.I. With the first two both decision times and movement times were examined separately. The irregular P.I. situation was included as a check on the earlier findings, so only decision times were analysed.

It is clear that the schizophrenics as a group are significantly slower both in their speed of decision and in the movement component. The slow speed on the decision component, is of course, well established in the literature, but the evidence for motor retardation in schizophrenics is less well-recognised. As no significant difference was found between the movement times of patients on drugs and those who were drug-free it is clear that this retardation is not simply due to extra-pyramidal side-effects of psychotropic drugs. The evidence presented in Chapter 3 was strongly suggestive of a motor retardation (measured there with the peg-board) but with less rigorous control of variables in the clinical experimental situation, it was not possible to be dogmatic. This more careful isolation of the movement component together with more control over other variables adds confidence to the earlier cautious conclusions.

The variance due to subjects has been substantially eliminated by the use of a careful control group, matched closely for age and sex.

(b) Choice R.T.

Analyses of variance were carried out as for the simple R.T. situation, with the addition of complexity as a variable. The results are contained in Table 6.4.

Influence of presentation sequence

Mean scores were examined to discover whether different orders of presentation influenced the results. The trends for each order were uniform with the 8-choice times consistently longer than the 4-choice times which were longer than the 2-choice times. All the differences were significant except those for the order 2, 8, 4. It is therefore concluded that, while it was appropriate to design the experiment in the manner described, there was no significant effect attributable to order of presentation.

(a) Simple R.T. with regular P.I.

Analyses of variance were carried out on the simple R.T. In Table 6.3 the influence of mental state (patients vs. normals) (regular P.I.) and matched pairs of subjects (abbreviated as "subjects") is shown. A treatment x levels design was used (Lindquist 1953).

	Degrees of Freedom	MOVEMENT LOG SCORES				DECISION LOG SCORES			
		S.O.S.	Mean Sq.	F	P	S.O.S.	Mean Sq.	F	P
Mental State	1	512,740	512,740	22.4	.01	217,218	217,218	11.7	.01
Sub-jects	23	590,244	25,662	1.12	N.S.	429,598	18,678	1.0	N.S.
M.S x S	23	527,104	22,917	-	-	424,923	18,474	-	-
Total	47	1,640,088	-	-	-	1,071,739	-	-	-

Table 6.3 - Sources of variance with simple R.T.

SOURCE	Degrees of Freedom	MOVEMENT LOG SCORES				DECISION LOG SCORES			
		S.O.S.	Mean Sq.	F	P	S.O.S.	Mean Sq.	F	P
Mental State	1	11,808	11,808	20.9	<.01	682,276	682,276	37.8	<.001
Subjects	23	8,771	381	0.6	N.S.	824,182	35,834	1.98	<.05
Complexity	2	3,059	1,530	45.0	<.01	44,036	22,018	3.2	<.05
M.S. x S.	23	12,956	563	16.5	<.01	414,559	18,026	2.65	<.01
M.S. x C.	2	161	81	2.3	N.S.	606	303	0.04	N.S.
S. x C.	46	1,527	33	1.0	N.S.	39,215	853	0.12	N.S.
Residual	46	1,569	34	-	-	312,909	6,802	-	-
TOTAL	143	39,851	-	-	-	2,317,823	-	-	-

Table 6-4 - Sources of variance with choice R.T. data.

It is apparent that the most significant effect is mental state, with the patients performing worse than the normal control group. There is no significant effect among subjects with movement times but the significant difference with decision times is identifiable as being due to sex - the mean for males being faster than for females.

The contribution to total variance of complexity is far greater with movement times than with decision times. This is very simply due to the different distances involved in the response situations. The 4-choice situation involved the greatest distance, since only the outer keys were used whereas with the 8-choice situation half the responses were to the nearer keys. With the decision times one notes a lesser but significant effect ($P \simeq .05$) in which subjects took longer to respond the more complex the sitation became (see Fig. 6.3).

There is finally the highly significant interaction of Mental State X subjects. Reference back to the raw data shows that this is due to an interaction between sex and mental state. Table 6.5 shows that whereas the range of scores among the normals is comparable, the male schizophrenics were far more variable than the female schizophrenics. The fastest and slowest patients were males, while the females clustered more closely around the mean.

Decision times in milliseconds.

		MEAN	RANGE
NORMALS	- Male	338	258- 395
	- Female	337	272- 441
SCHIZOPHRENICS	- Male	456	276-1130
	- Female	457	385- 650

Table 6.5 - Main decision times and range of times for patients and controls in relation to sex differences.

(c) Simple R.T. with Irregular P.I.s

The collection of the data within this category did not bear on the hypotheses outlined so far in this chapter, but served as a further check on the earlier results reported in chapter 3. The sequence of twenty responses was directly comparable with that already used, so the opportunity was taken to see if previous findings would be confirmed under more controlled conditions. Two differences

did actually exist but it was predicted that they would be unimportant and proved to be so. The longest P.I. used was 12 secs. instead of 16 secs., and the response situation involved a jump R.T. but only the decision time score was used.

The importance of P.I. for schizophrenics and for normals is shown in Fig. 6.5 It is again clear that it is with short P.I.s that the greatest difficulty occurs. The absolute levels are closely similar to those found with the previous group of schizophrenics (see Fig. 3.17) There is also confirmation here of the schizophrenic's inability to maintain a major set (Shakow 1962), in that performance is relatively poorer with the 12 sec. P.I. than is found with normals who function at an optimum level with a P.I. of 4 secs. and greater.

One purpose of devising the sequence of irregular P.I.s in the fashion already described was to examine the effect of one preparatory interval on the subsequent one. It became apparent in a pilot run that when a short P.I. followed a long P.I., patients performed much worse in the second response situation than did normal subjects. It was clear that a set was developed during each P.I. which patients found difficult to modify when a very different length of P.I. followed. It therefore seemed worthwhile to examine the influence of what may be called the pre-preparatory interval (P.P.I.).

The effect of P.P.I. is represented graphically in Fig. 6.6 The curve for normals shows a linear change such that longer P.P.I.s tend to produce longer R.T.s. The differences are consistent but not great. By contrast, the schizophrenic group shows great variability.

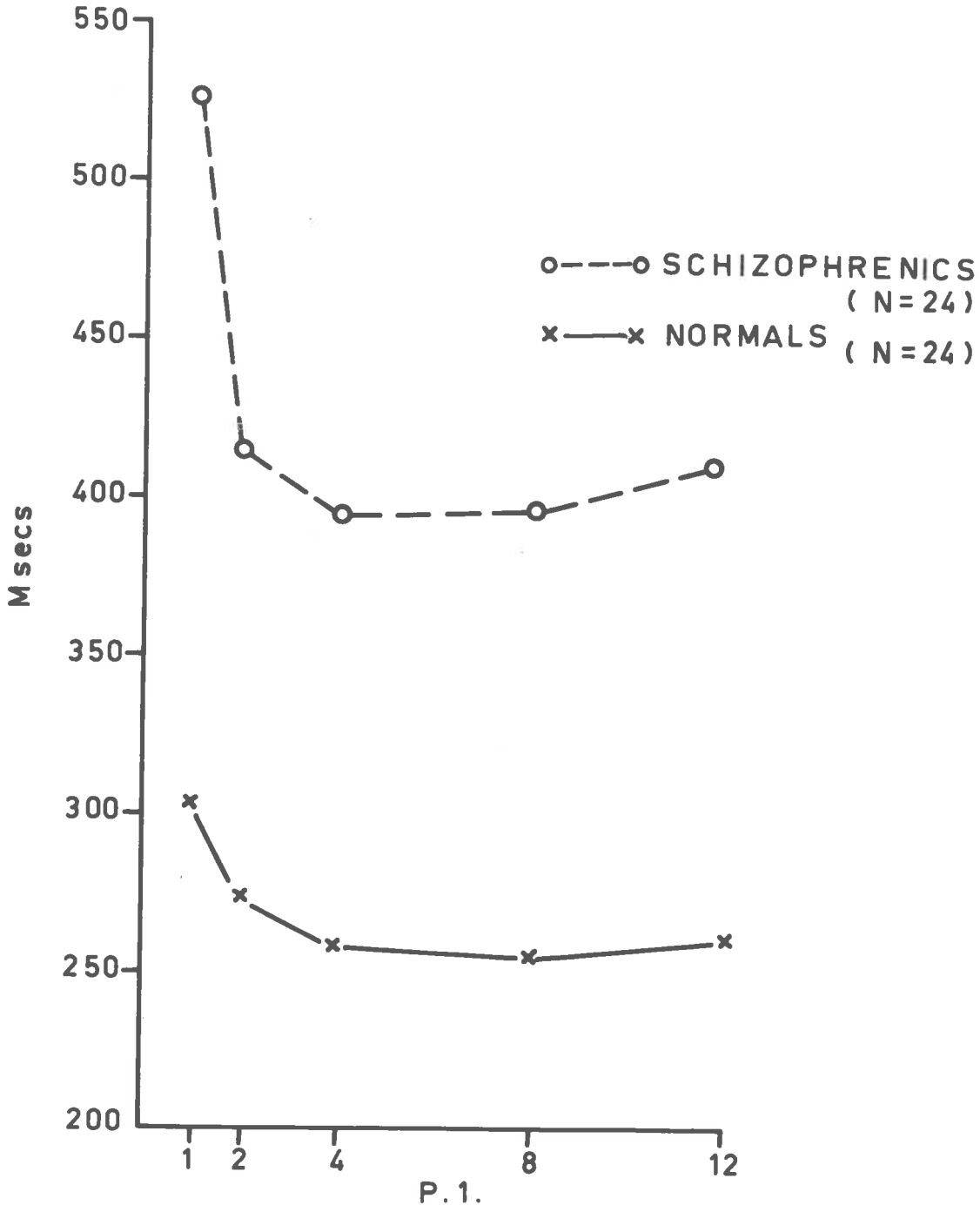


Fig 6.5 THE EFFECT ON SIMPLE R.T. OF LENGTH OF P.1 FOR SCHIZOPHRENICS AND NORMALS

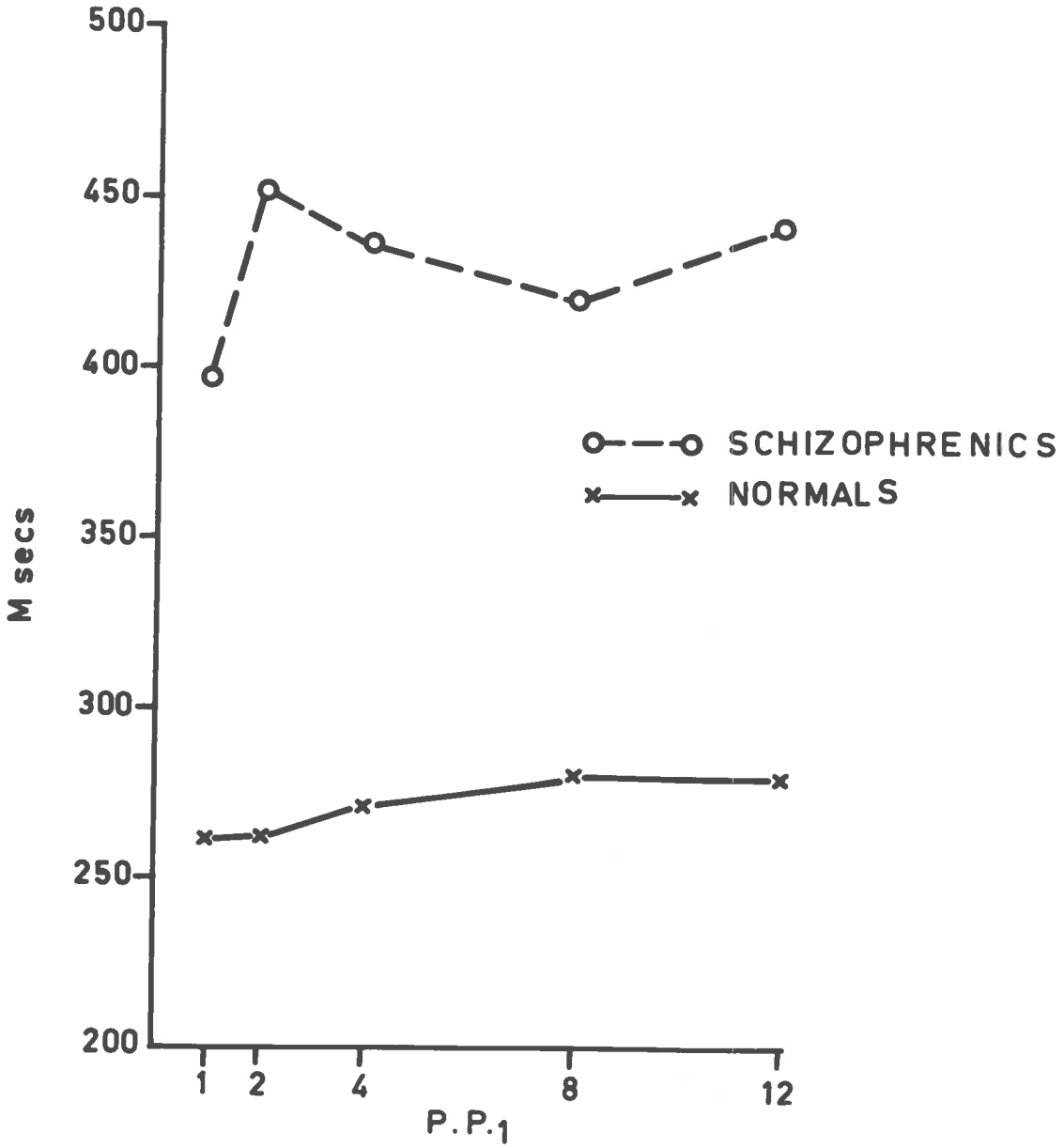


Fig. 6.6 THE EFFECT ON SIMPLE R.T. OF LENGTH OF $P.P._1$ FOR SCHIZOPHRENICS AND NORMALS.

It would appear that, having developed a set to responding rapidly (1 sec. P.P.I.) the next response is also produced rapidly, whereas when there has been a long wait (12 sec. P.P.I.) the following response is a slow one. The 4 and 8 sec. P.P.I.s involve a conscious development of a set to wait for the stimulus, but still within the limits of waiting which schizophrenics have been shown able to handle. The long R.T. following a P.P.I. of 2 secs is the result of the rapid succession occurring when the P.I. is one second, i.e. shorter than the P.P.I.

One may infer from the difference in pattern of response between schizophrenics and normals, that the schizophrenic is influenced by what has just happened to a greater degree than the normal subject. He is less able to readjust to what may occur next. He therefore has relatively less difficulty in handling regularly recurring material than he has when the onset of the next stimulus follows an irregular sequence.

CHAPTER 7.

PSYCHOMOTOR CHANGES IN ENDOGENOUS DEPRESSIVES UNDERGOING TREATMENT.

Introduction and hypotheses

Procedure

Results

Discussion

PSYCHOMOTOR CHANGES IN ENDOGENOUS DEPRESSIVES UNDERGOING TREATMENT

Introduction and Hypotheses

It was shown in Chapter 3 that when performance on simple R.T. is compared with the psychiatrist's clinical opinion, there is substantial agreement between the two if psychotic patients are under consideration. A 79% agreement was obtained among the 67 psychotic patients assessed (see Table 3.15). A sub-group of 10 depressed patients appeared not to improve on the simple R.T. measure used although rated clinically as improving, and this discrepancy was found to relate to the administration of E.C.T. Where patients were treated for depression with E.C.T. they improved clinically, but the confusional effects resulted in poorer R.T. scores than would otherwise have been expected. This was sufficient to reduce or destroy the correlation between measures in some cases though in others the degree of clinical improvement more than offset the E.C.T. side-effects and improvement could still be identified.

In that experiment, the psychiatric ratings were, for reasons outlined earlier, less precise than could have been wished for evaluating the psychomotor measures. To establish the reliability of simple R.T. as an indicator of psychiatric status, a further experiment was carried out on depressed patients. It was decided to examine some patients receiving E.C.T. and compare the results with a group receiving drug therapy.

Depressed patients were also chosen because of the availability of a rating-scale (Hamilton 1960) which is appropriate for use by an independent observer and yields a score against which the reliability of the simple R.T. could be more precisely judged. The Hamilton Rating Scale for Depression (H.R.S.) was scarcely known when the work in Chapter 3 was initiated and had certainly not proved itself as an adequate research instrument, but in the interval it has been used and developed to the point that it is now a valuable adjunct to research (Hamilton 1967). It provides a possible range of scores covering the features of depression. It is not a diagnostic tool, but simply intended to provide a measure of the degree of depression among patients where the diagnosis has already been made.

It is important to note that, even when an unequivocal diagnosis has been made, some patients will demonstrate symptomatic changes in response to treatment which are not covered by the items of the H.R.S. Side-effects of drugs or E.C.T. are cases in point. Hence, there is value in having some more global measure of psychiatric status. A useful contribution has been the recent development of the Symptom-Sign Inventory (S.S.I.), pioneered by Foulds (1965). His purpose has been to develop measures to give assessments of the personality structure which will remain relatively unchanged during illness, as well as measures which will change with clinical change. The Hysteroid-Obsessoid Questionnaire aims to provide a relatively constant measure, and the S.S.I. to assess degrees of change.

That this proves to be the case has been confirmed with depressed patients (Mayo 1967).

It is therefore now possible to assess depressed patients at successive points during treatment with tools devised to reflect clinical change. The H.R.S. is in effect a standardised clinical interview and provides a measure of the psychiatrist's judgement of a patient. For it to be of value, the rater has to be both a competent clinician and familiar with the scale. The S.S.I. demands less skill in administration, simply requiring a "Yes-No" answer to 80 questions. This provides an assessment of the patient's subjective view of himself.

With these two rather different measures, the simple R.T. may be compared. That slowing of R.T. among depressed patients is not simply due to retardation or to physiological under-reactivity has been shown by Martin and Rees (1966) who identified a reduced discrimination and muscular hyper-reactivity among "reactive" depressives, in examining groups of endogenous depressives, mixed depressives and normals. They postulated that poor motivation and lack of concentration may have influenced their results, but did not analyse the relative importance of these.

It may be hypothesised that there will be:

1. A positive correlation between changes on simple R.T. and H.R.S.
2. A positive correlation between changes on simple R.T. and S.S.I.
3. A breakdown of the relationship between simple R.T. and

and other measures among those patients treated with E.C.T. because of side-effects.

4. A closer relationship of simple R.T. to S.S.I. than to H.R.S. since the former gives a broader assessment of psychiatric status.

Procedure

Arrangements were made with a psychiatrist responsible for a psychiatric hospital admission unit to refer all patients having an endogenous type of depression for assessment as soon as possible after admission. That is, patients diagnosed as involutional melancholia, endogenous depression and manic-depressive psychosis, depressive type would be included, but neurotic or reactive depressions would be excluded. Since the psychotic type of depression is typically responsible for a large percentage of admissions to psychiatric hospitals, it appeared that numbers would be no problem. This was checked against hospital admission records which confirmed a probable availability of 2-3 new patients per week. It is therefore noteworthy that the first suitable patient was seen nearly three months later and after six months only five had been obtained. In the meantime alternative arrangements were made to obtain patients through the University Department general Hospital beds. Ten patients were obtained over the same period in this way. One disadvantage of this arrangement was that the co-operation of two more psychiatric colleagues was needed, who also administered the H.R.S. The psychomotor testing also had to be conducted in

three different locations rather than one. Both these factors may have tended to reduce the reliability of the overall measures.

The absence of suitable patients prolonged the collection of data beyond the expected time. This delay emphasises that the majority of straight-forward depressed patients are now treated effectively by their general practitioner. A larger group of patients might have been obtained more rapidly by accepting borderline cases, but a small group with rigorous criteria was preferred.

In this study the whole psychomotor battery was administered as before, in order to preserve a standard test situation and makes results comparable with those in Chapter 3, but since only the relationship between simple R.T. was being compared with the H.R.S. and S.S.I., results from the handwriting and peg-board tasks have not been analysed. The S.S.I. was administered following the psychomotor tasks to avoid any contamination of R.T. scores. The psychiatrist responsible for the patient administered the H.R.S. independently and made the results available at a later time - again to avoid contamination. This procedure was repeated at two weeks and at four weeks with the proviso that if testing were due on a day when E.C.T. was given, it was delayed until the day following treatment.

Scores from the H.R.S. and S.S.I. were recorded and used as raw scores, the former having a range of 0-60, the latter 0-80. The mean R.T. over twenty trials was obtained and transformed as in the study in Chapter 3 into a log score (the mantissa x 100).

These results are summarised in Appendix IV.

The 15 patients consisted of 11 women and 4 men, with a mean age of 52 years (range 27-77). Nine were treated with drugs and six with E.C.T. Generally a striking improvement was noted, but in 4 cases, patients failed to respond during the month of being assessed. One patient responded to E.C.T., but an underlying dementing process was revealed; one patient became floridly paranoid, but then recovered; and two patients became mildy hypomanic by the last occasion of testing.

The trends in scores for the whole group of 15 patients as well as for the two sub-groups of pattern on E.C.T. and drug therapy respectively are summarised in Fig. 7.1. By inspection one notes that all three measures show that patients receiving E.C.T. were as a group more severely ill initially than the drug group. (This fact would serve as one criterion for the use of E.C.T.). All three measures are consistent in demonstrating improvement during the period of study.

For those receiving E.C.T. a sharp improvement appears over the first two weeks, but less improvement appears later. The former reflects the immediate response to E.C.T. commonly found, while the latter trend probably arises from the side-effects of E.C.T. to be discussed below. Those receiving drugs show the opposite trend with slight improvement initially giving way to greater improvement in the second fortnight. This is entirely consistent with the usual mode of action of anti-depressant drugs

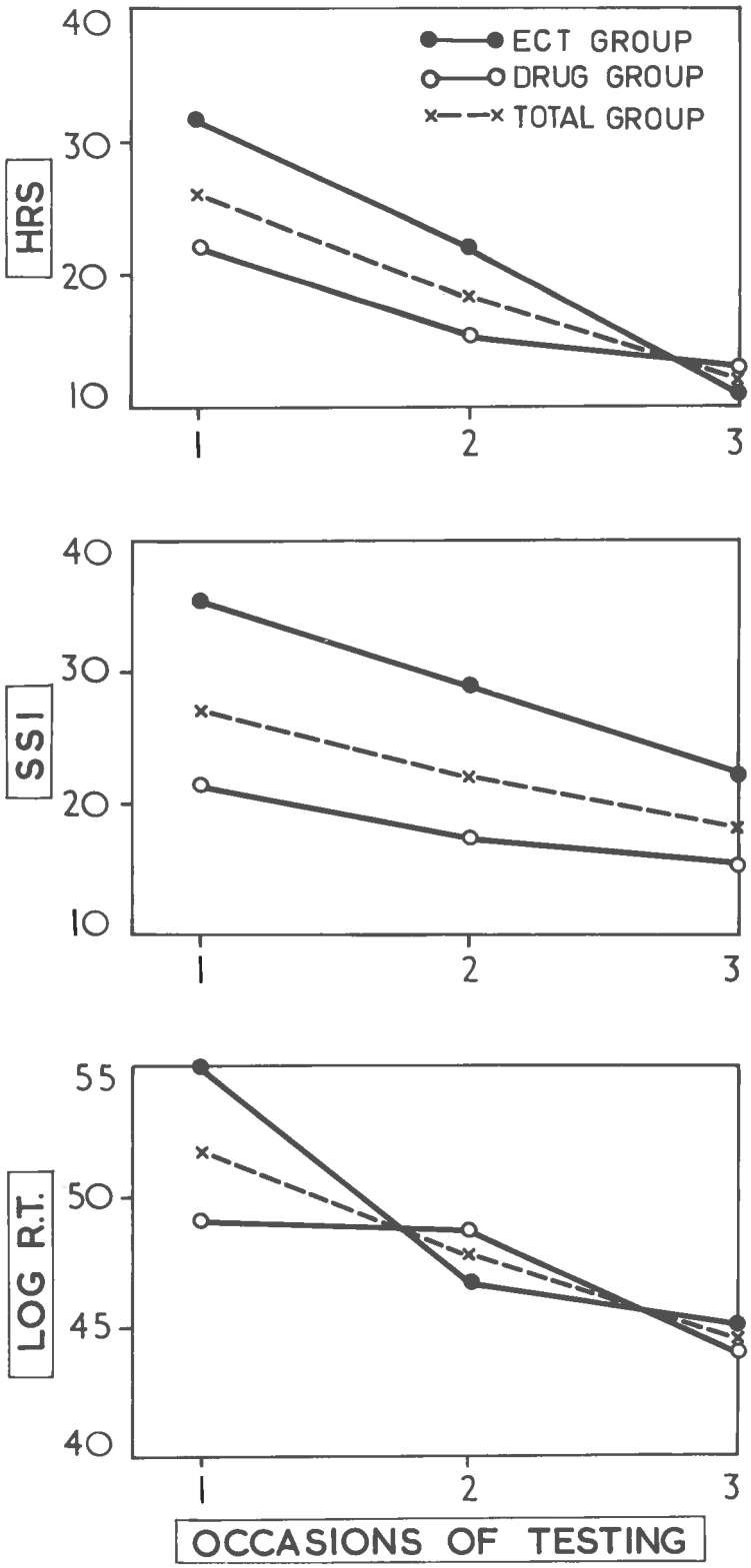


Fig. 7.1 CHANGES IN TEST SCORES BY DEPRESSIVES OVER 1 MONTH of TREATMENT.

whose effect is often not felt until 2-3 weeks have elapsed.

To demonstrate the value of the simple R.T. as a criterion of improvement, it is necessary but not sufficient to show trends such as these. More to the point is to show whether the relationship is sustained sufficiently often with individual cases for the coefficient of correlation between groups to reach statistical significance.

	H.R.S.	S.S.I.	R.T.
H.R.S.	-	+0.57*	+0.62*
S.S.I.	-	-	+0.41
R.T.	-	-	-

Table 7.1 - Correlation between overall difference scores (Occasion 3 - Occasion 1) for the total group.

* $P. < .05$

A comparison of results for the total group of 15 patients shows in Table 7.1. a significant relationship between the H.R.S. and the other two tests while the relationship of S.S.I./R.T. fell just short of significance. Since these values are coefficients of validity rather than reliability, it is usual to expect values up to around 0.60 (Guilford, 1965) and for so small a sample size can be considered satisfactory. When patients on anti-depressant drugs were separated from those receiving E.C.T. the relationship

between test scores for the two sub-groups were as shown in Table 7.2.

		H.R.S.	S.S.I.	R.T.
Drug Group (N=9)	H.R.S.		+0.57	+0.76*
	S.S.I.	+ 0.22		+0.72*
	R.T.	+ 0.63	+0.03	

E.C.T. Group (N=6)

Table 7.2 - Correlation between overall difference scores (Occasion 3 - Occasion 1) for drug and E.C.T. groups.

* $P < .05$

Among those patients receiving E.C.T. no significant relationships emerged. The confusional aspects of E.C.T. at the time of testing were presumably such that each measure was affected to a different degree, so that no clear-cut relationship emerged.

By contrast, the results with those patients on drugs show a significant and substantial relationship between simple R.T. and the two criterion measures, even though the two criterion measures themselves just failed to intercorrelate at a statistically acceptable level. This would suggest that, provided severe side-effects do not cloud the issue as with E.C.T. the simple R.T. measure gives a sensitive indicator of change in psychiatric state, whether one thinks in terms of depression as indicated by the Hamilton Scale or in terms of a broader assessment of psychiatric

dysfunction provided by the S.S.I. Although it was hypothesised that the simple R.T. measure would correlate more closely with the broader-based measure, no significant difference is evident with this sample-size.

Another way of looking at the relationships between test-scores is to compare changes over the first fortnight with those over the second fortnight, for the E.C.T. and drug groups separately. The intercorrelations are shown in Table 7.3. Two features emerge from these relationships:

(a) again little reliable correlation is found among patients receiving E.C.T. The one significant value (R.T./H.R.S. during the second fortnight) appears to be a chance finding not capable of psychological interpretation.

(b) There is a more consistent association between simple R.T. and S.S.I. scores than between the other relationships. This finding is consistent with the third hypothesis that was proposed.

		H.R.S.		S.S.I.		R.T.	
		Early	Late	Early	Late	Early	Late
H.R.S.	Early			+011		-0.10	
	Late				+0.54		+0.56
S.S.I.	Early	+0.32				+0.88*	
	Late		+0.50				+0.74*
R.T.	Early	-0.37		-0.01			
	Late		+0.90*		+0.65		

DRUG GROUP

E.C.T. GROUP

Table 7.3

'Early' = (Difference Score Occasion 2 - Occasion 1)

'Late' = (Difference Score Occasion 3 - Occasion 2)

* $P < .05$

Comparison of results of patients receiving drugs with those receiving E.C.T.

Discussion

The original hypotheses may now be reconsidered.

1. A positive correlation was postulated between changes on simple R.T. and changes on H.R.S.
   This relationship was established at a statistically significant level when changes over the month of treatment were examined. This was true for the whole group and for those receiving anti-depressants, but not for those receiving E.C.T.

2. A positive correlation was postulated between changes on simple R.T. and S.S.I.
   This relationship was established at a statistically significant level for those patients receiving antidepressants, both when the whole month's change was examined and when results for the first and second fortnights were examined separately. The relationship was not found among patients receiving E.C.T. nor with the combined E.C.T. and drug group.

3. The relationship between measures would be confounded by E.C.T.
   This proved to be clearly apparent on all the comparisons made. This finding is of special value in interpreting the results in Chapter 3 reviewed at the opening of this chapter.

4. A closer relationship was postulated between simple R.T. and S.S.I. than between simple R.T. and H.R.S. In fact the size of sample was such that a statistical difference could not be demonstrated conclusively, though results with the drug group shown in Table 7.3. do accord with this hypothesis.

However, the low relationship between H.R.S./R.T. on early testing is almost exclusively a product of one patient who became bizarrely paranoid. By the H.R.S. rating she was slightly better, since her depressive features were less in evidence, but both the S.S.I. and the R.T. measures agreed in revealing a great deterioration. Observations like this are particularly valuable in identifying exactly what is being measured by the simple R.T. - if it were the psychomotor retardation of depression as appears to be the case with some other psychomotor measures, then one would expect the simple R.T. to correlate most highly with the H.R.S. The more reliable correlation with the S.S.I. is consistent with the hypothesised value of simple R.T. as a measure of "total organism integrity or effectiveness."

The same conclusion may be drawn from the differences between results of E.C.T. patients from those on drugs. The latter produced consistently better scores as they got better. The former failed to improve on simple R.T. as much as clinical improvement would lead one to expect, and this was especially apparent towards the end of the course of treatment when several scores showed a

deterioration in the face of clinical improvement. Clearly central nervous system efficiency had been temporarily reduced as is well known in studies of the ongoing effects of E.C.T. (Brower and Oppenheim 1951, Hetherington 1956).

It would appear from a study by Blacker, Hargreaves and Stone (1968) that the decision to defer testing to the day following E.C.T. where treatment and testing would otherwise have coincided may have exaggerated rather than minimised confusional effects. They report that with a temporal maze test confusion increases to a peak for a day or two following a convulsion and then declines.

In addition to testing these hypotheses, the results obtained here once again demonstrate that simple R.T. offers a useful indicator of severity of illness. Changes in severity are matched by concomitant changes in mean R.T. level. Arising from this the data on manic-depressives in Chapter 3 and Chapter 5 have been taken as the basis for a revised conceptual model of manic-depressive psychosis. The extended argument taking into account work from many other fields does not readily fit into the framework presented here, but as it is awaiting publication (Court 1968), a summary is included in Appendix V.

CHAPTER 8

SUMMARY AND DISCUSSION OF FINDINGS.

CHAPTER 8

SUMMARY AND DISCUSSION OF FINDINGS.

The initial impetus for this study was the need for psychological tests which can be readily administered in a clinical context to provide information about the clinical condition of acute psychiatric patients. The general area of psychomotor activity was selected as an appropriate one in the light of earlier reported work. However, most of this related to chronic conditions and applicability in the acute context had not been demonstrated.

The sequence of events which has been described may be summarised as follows. From the wide range of possible tests, a small battery was selected to give measures of speed and size. It is not claimed that they are the only or even the best tests on theoretical grounds for the purpose, but they were chosen to conform to the usual criteria for measuring instruments, viz. objectivity, reliability, validity, sensitivity, comparability and utility. The battery was administered to a first group of 44 patients, all from one acute admission unit and with no policy of selection other than availability. At the same time a group of 34 normal subjects was tested for comparative purposes.

These two groups served as a basis for scoring criteria to be compared with psychiatric ratings retrospectively. Having set up standards of scoring giving optimal agreement with psychiatric ratings retrospectively, a prospective group of 56 patients was tested, together with 7 more normal subjects.

Results obtained from the battery were described in Chapter 3 and may be summarised as follows:

(1) Handwriting remains constant in speed and size among normal subjects, but is sensitive to changes in mood among manic-depressives.

(2) Manual dexterity assessed by the peg-board was significantly slower than normal with all patient groups. Depressives showed a significant improvement in performance with recovery.

(3) A method for transforming the skewed distribution of reaction time scores was described which makes the application of parametric statistics appropriate.

(4) Sex was found to be a significant independent variable with simple R.T. but neither age nor diagnosis alone were significant.

(5) Patients improved significantly over the three occasions of testing, but normals did not.

(6) Over the first three weeks acute schizophrenics and neurotics improved most. Organics showed slight improvement but significant deficit remained after six weeks.

(7) On an initial group of 44 patients, a cutting-point was established which, when compared with psychiatric assessment correctly classified 82%.

(8) The same criterion used propectively with a further 56 patients correctly classified 68%.

(9) With the total group of 100 patients, a significant group of "misclassified" patients was identified as those receiving E.C.T.

In addition psychotics were more reliably classified (79%) than neurotics (62%). This demonstrates that a very high degree of confidence may be placed in measures derived from psychotic patients not receiving E.C.T. This is probably the single most significant clinical contribution of this study.

(10) The effect of drugs on simple R.T. was, when compared with other sources of variance, insignificant.

(11) The relationship between peg-board and simple R.T. results was examined in terms of the effects of age and diagnosis. It was concluded that schizophrenics and depressives show impairment of both central and peripheral processes.

Having established that a psychomotor battery is an appropriate and reliable one in the acute psychiatric context, later chapters explored its uses more specifically. To be of value, data must serve not only for groups but also for individuals. Five individual studies were reported in Chapter 4 about whom more detailed information was available. The changes in response level showed a close correlation with the clinical situation, sufficiently precise for management decisions to be based on results.

The value of a battery of tests rather than one single psychomotor task was shown with a group of ten patients being treated with Haloperidol (Chapter 5). All the group derived benefit from this drug, and all the group developed clear side-effects, but no suggestion is made that clinical improvement and the appearance

of side-effect necessarily go together.

There is some evidence that patients with delusional symptoms experience an affective change appreciably earlier than the loss of their delusions.

With psychomotor testing, it was shown that, with the appearance of drug side-effects, there is a reduction of speed of performance of continuing tasks and the appearance of micrographia, but that the speed of initiating a single response (as assessed with simple R.T.) is relatively unaffected. When the therapy also results in an improvement in mental state, this is reflected in a reduction of size of handwriting, an increase of output on continuing tasks, and a reduction in reaction time for both long and short preparatory intervals.

It is concluded that this study demonstrates the importance of using a battery of tests rather than relying on a single measure. Reaction time is scarcely affected by the side-effects of Haloperidol. Heilizer (1959) made a similar observation in relation to chlorpromazine and Brooks and Weaver (1961) confirmed this with trifluoperazine, but the effect with a butyrophenone has not previously been studied. By contrast, tasks of manual dexterity are sensitive to the side effects of Haloperidol, as Weaver and Brooks (1961) have shown with phenothiazines.

On the assumption that some fundamental aspect of mental illness is measured by psychomotor tasks, the R.T. task was modified to introduce increasing degrees of complexity.(Chapter 6). In this way a hypothesis about the nature of the schizophrenic deficit was examined viz. that because of reduced efficiency in information processing, the schizophrenic will experience relatively greater difficulty in responding appropriately to increasing information content than normals. With a sample of thought-disordered acute patients this prediction was not confirmed. Furthermore, the hypothesis that the problem would be especially apparent among non-paranoids was examined and not confirmed.

It was however shown that schizophrenics are less able to maintain an appropriate set to respond when preparatory intervals occur in an unpredictable sequence. This finding is no longer original as it has now been reported (Zahn, Rosenthal and Shakow, 1963) but information on the effect of P.P.I. on other psychotic groups has not been reported. The affective psychoses are shown also to have a greater variability of response, rather similar to the schizophrenic group. The greatest similarity is between hypomanics and manic-depressive depressions, and the interpretation offered is that hypomania is best viewed as a defence against depression (i.e. a more extreme disturbance than depression) rather than being at the opposite end of a continuum which includes normals in the centre.

Although in Chapter 3, performance on simple R.T. was compared with an independent psychiatric assessment, it was noted that the clinical judgements inevitably lacked precision. A further study was therefore carried out (Chapter 7) to establish whether the relationships previously obtained would be repeatable with more precise external criteria. A group of endogenously depressed patients was given the Hamilton Rating Scale by a psychiatrist independently of the administration of Foulds' Symptom-Sign Inventory and the psychomotor battery. Even with a fairly small group of patients it was possible to show a high correlation between measures except when patients were being treated with E.C.T. The fact that simple R.T. correlated more reliably with S.S.I. than with H.R.S. again demonstrates that more than a symptomatic measure of retardation is being obtained. A more general measure of organism integrity is being tapped.

The evidence from collecting results with a variety of diagnostic groups is that psychomotor deficit is not peculiar to the organic or the schizophrenic patients, nor does it appear that diagnostic differences are readily distinguishable. It emerges rather that deficits relate to severity of illness. Thus the proper use of a psychomotor battery in a clinical context is not a diagnostic one, but to assess the relative severity of disturbance.

In this study, this principle has been applied for the first time to a sample of acute patients, with repeated testing at intervals during treatment. External criteria show that the

procedure is sensitive enough to be applied in both extensive and intensive studies with psychotics.

While the application of a psychomotor battery to acute psychiatric patients is fraught with complications of motivation, sedation, etc., the overall conclusion from this study is that with psychotic patients, severity of illness is the most significant variable. When checked through time and with a variety of conditions, the evidence is of a procedure which is both sensitive and reliable enough to provide both theoretical and practical information.

APPENDIX I.

ADDITIONAL DATA RELATING TO SUBJECTS REPORTED IN CHAPTERS 2 and 3.

APPENDIX I.

Additional data.

Simple Reaction Time.

1. Mean R.T. (in msecs.) on the first occasion of testing for patients (100) and normals (41) at each preparatory interval. (See Chapter 3).

	Preparatory Intervals				
	1	2	4	8	16
Normals	329	285	261	265	260
Schizophrenics	499	407	356	357	350
Depressives	496	397	342	321	335
Hypomanics	513	454	378	366	402
Alcoholics	388	307	287	284	274
Organics	524	459	369	353	366
Neurotics	494	416	364	360	380
Psychopaths	380	319	269	248	390

(See Fig. 3.7)

2. Age and sex breakdown of mean R.T.'s (in msecs.) for patients and normals.

	Normals (41)	
	Male (23)	Female (18)
≥40+ (12)	262	298
<40 (29)	235	282

	Patients 100	
	Male (42)	Female (58)
40+ (58)	312	335
<40 (42)	490	379

(See Chapter 3)

3. Frequency Distribution of Reaction Times (41 Normals).

R.T. (msecs.)	F	R.T. (msecs.)	F.
110	1	370	17
140	1	380	15
150	5	390	8
160	2	400	11
170	3	410	9
180	9	420	8
190	15	430	12
200	26	450	3
210	41	460	3
220	45	470	6
230	60	480	1
240	63	500	4
250	60	510	1
260	63	520	1
270	61	530	2
280	55	540	2
290	43	550	2
300	46	570	2
310	31	580	1
320	13	590	1
330	20	650	2
340	17	670	1
350	16	750	1
360	11	780	1

4. Frequency Distribution of Reaction Times (100 Patients).

R.T. (msecs.)	F	R.T. (msecs.)	F
110	1	380	50
130	2	390	31
140	2	400	41
150	1	410	38
160	3	420	39
170	8	430	33
180	16	440	31
190	25	450	38
200	44	460	24
210	48	270	38
220	43	480	35
230	58	490	20
240	70	500	23
250	68	510	24
260	64	520	25
270	70	530	15
280	78	540	15
290	72	550	18
300	69	560	12
310	76	570	16
320	74	580	18
330	55	590	11
340	53	600	11
350	63	610	13
360	44	620	15
370	49	630	15

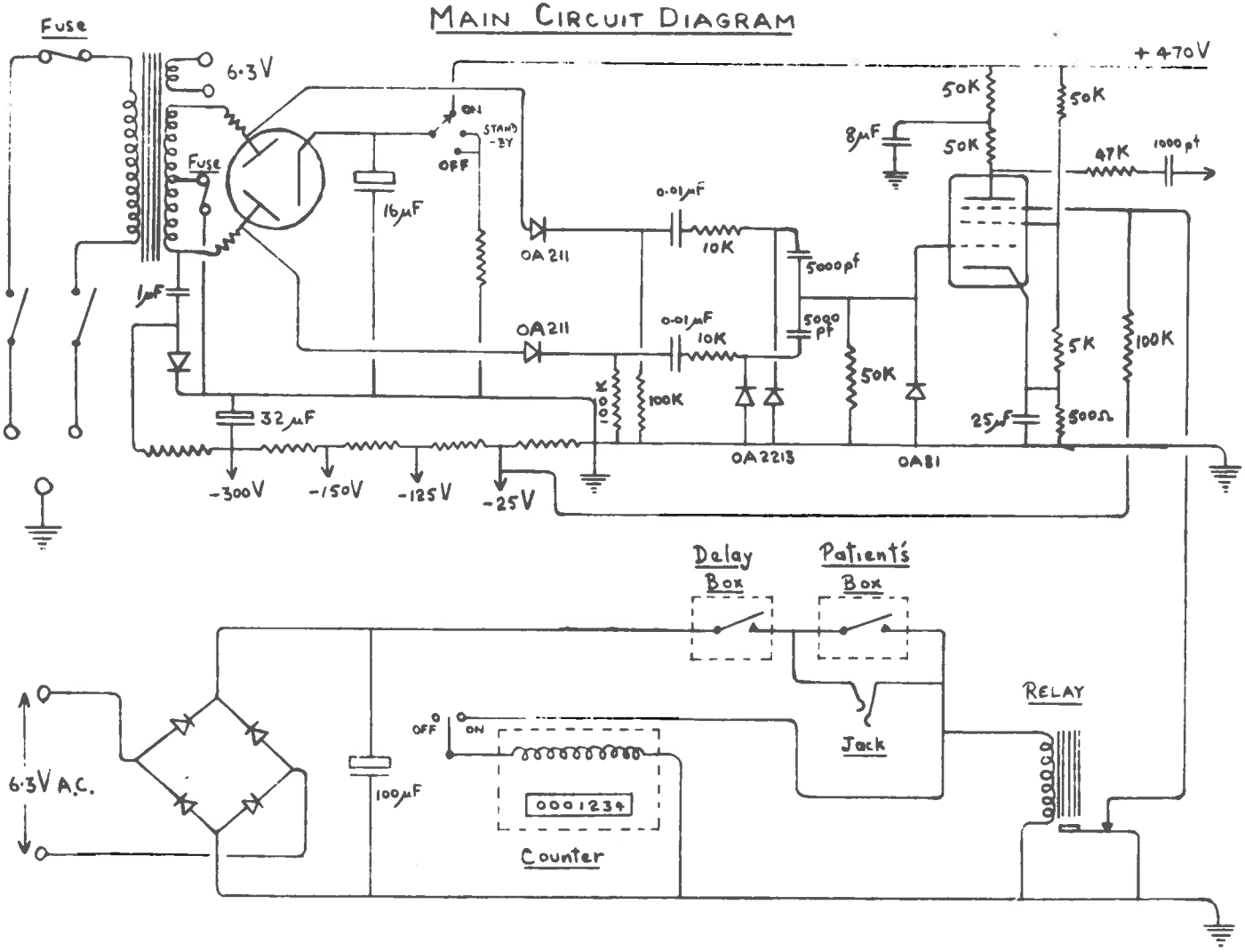
R.T. (msecs.)	F	R.T. (msecs.)	F
640	11	950	1
650	8	960	6
660	10	970	5
670	7	980	3
680	9	990	2
690	9	1000	2
700	7	1020	1
710	8	1030	1
720	6	1040	3
730	8	1050	1
740	2	1060	1
750	3	1070	2
760	4	1080	2
770	5	1100	2
780	2	1110	4
790	3	1120	1
800	4	1130	1
810	1	1140	4
820	5	1170	2
830	3	1180	2
840	2	1200	1
850	2	1210	2
860	1	1220	1
870	1	1280	2
880	1	1290	1
890	1	1300	1
900	4	1310	1
910	1	1340	1
920	1	1370	1
940	2	1380	1

R.T. (msecs.)	F.	R.T. (msecs.)	F
1410	1	1990	1
1420	1	2050	1
1450	1	2070	1
1470	3	2210	1
1570	1	2220	1
1670	1	2440	2
1760	1	2550	2
1900	1	2820	1
1920	2	3010	1
1950	2	4940	1

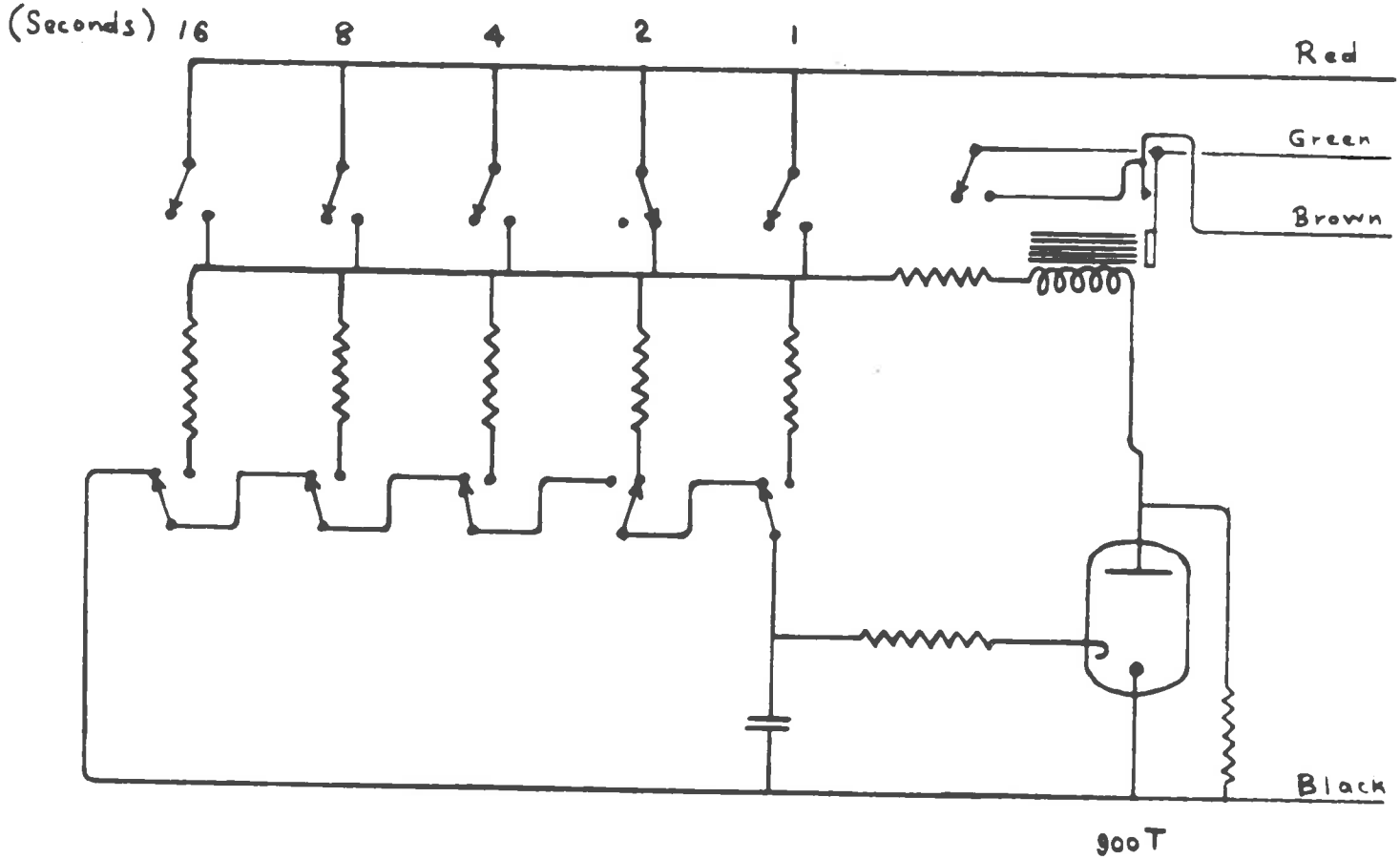
APPENDIX II

TECHNICAL DETAILS OF TIMER FOR MEASUREMENT OF SIMPLE R.T.

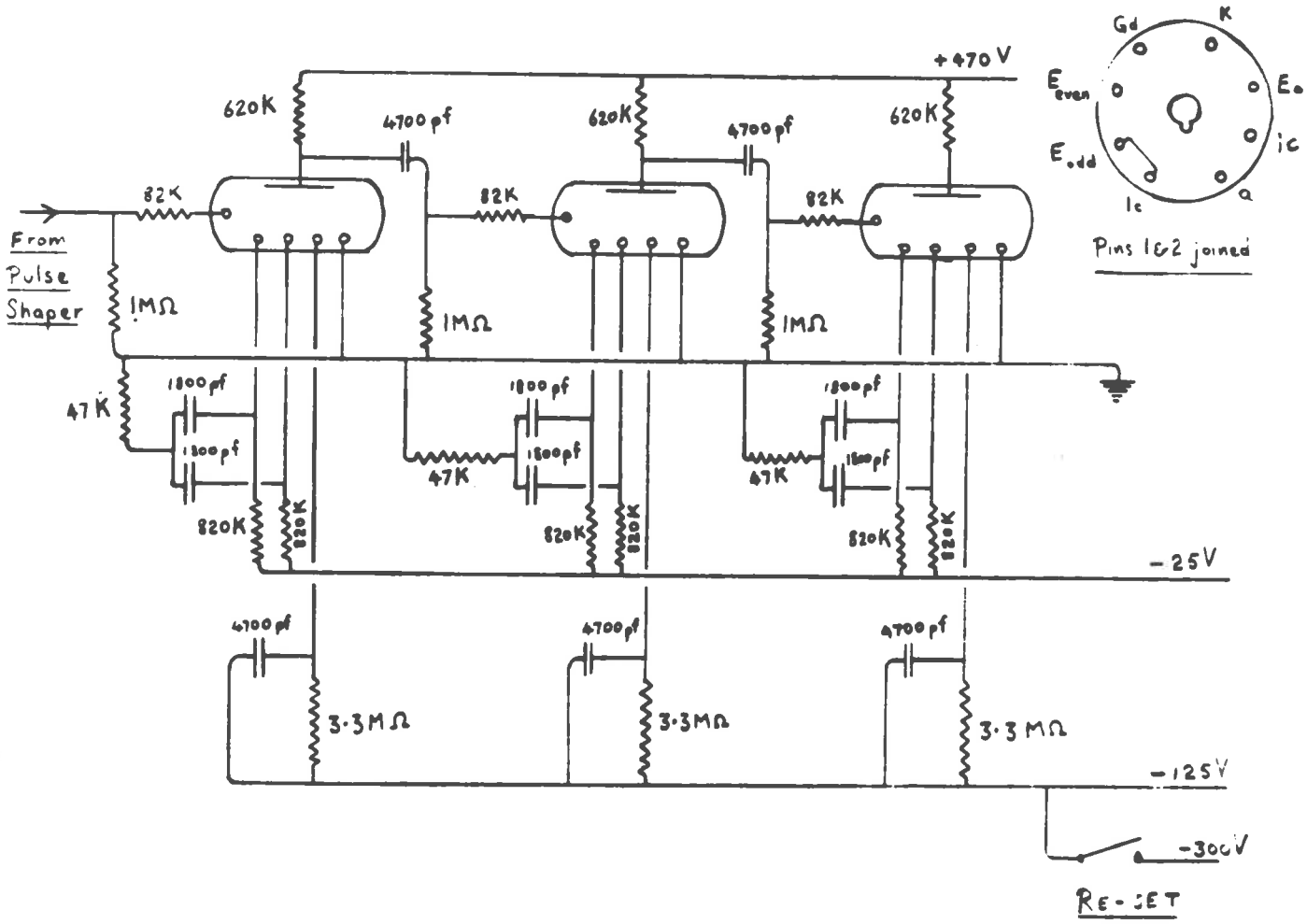
MAIN CIRCUIT DIAGRAM



Circuit Delay Box

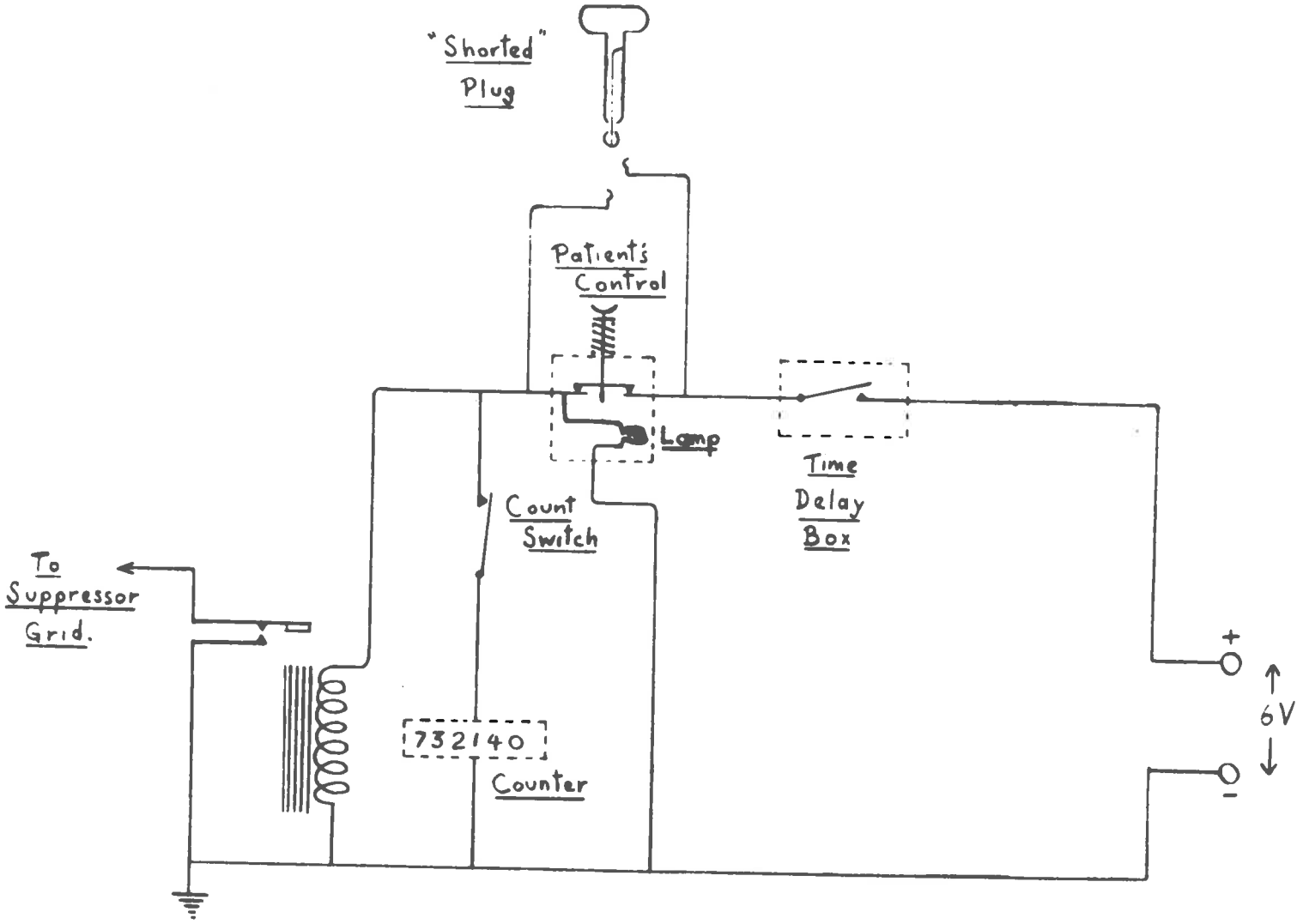


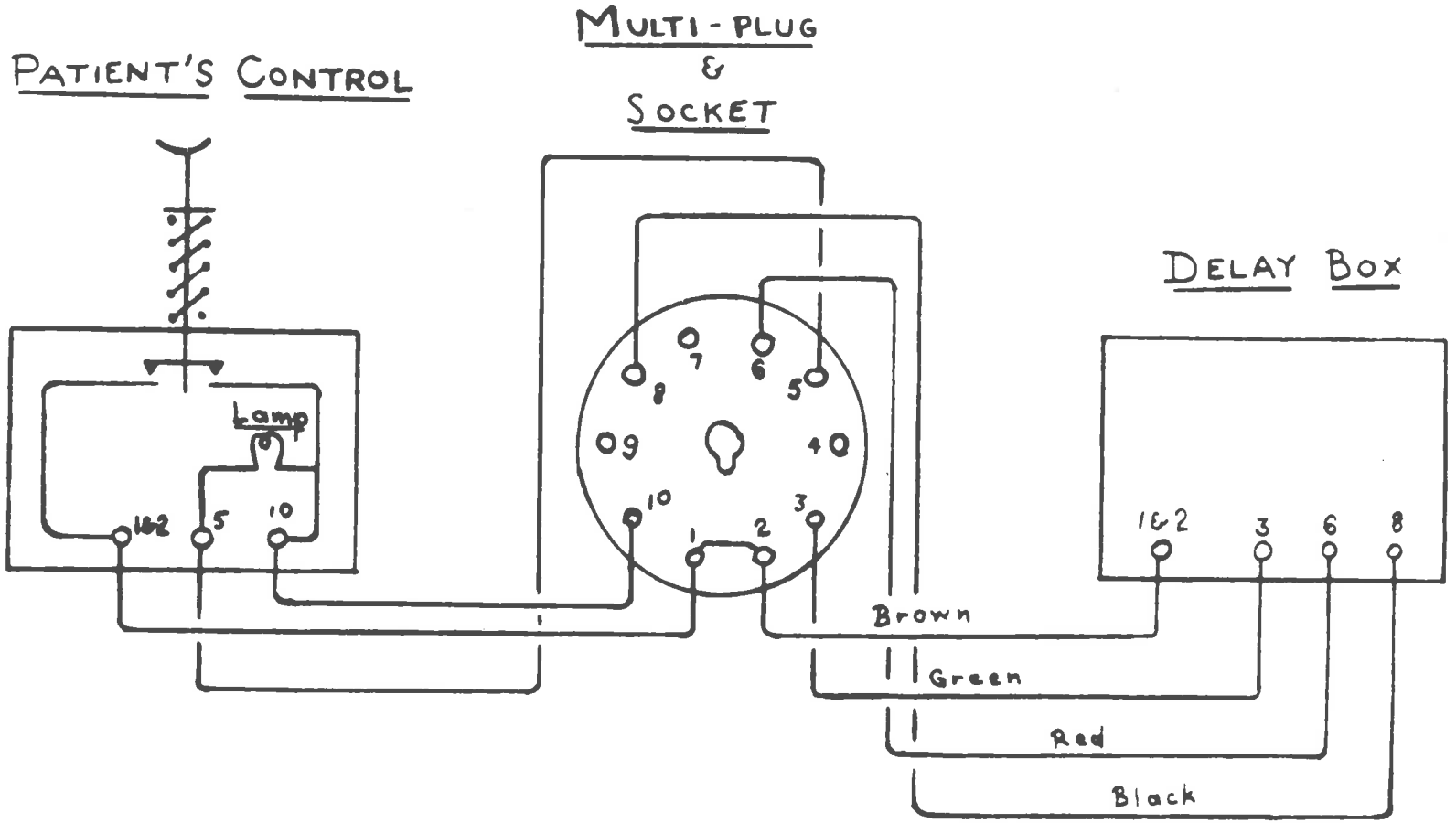
TIMER



Base Z302C

Pins 1&2 joined


"Shorted" Plug
Patient's Control
Lamp
Time Delay Box
Count Switch
To Suppressor Grid.
732140
Counter
+
6V
-


PATIENT'S CONTROL
MULTI-PLUG
&
SOCKET
DELAY BOX
Lamp
1&2
5
10
7
6
8
5
9
4
10
3
1
2
1&2
3
6
8
Brown
Green
Red
Black

APPENDIX III

DETAILS OF THE SAMPLE OF THOUGHT-DISORDERED SCHIZOPHRENICS

(See Chapter 6)

DETAILS OF THE SAMPLE OF THOUGHT-DISORDERED SCHIZOPHRENICS

Patient	Age	Sex	Previous Hospitalisation	Present Hospitalisation	Paranoid	Psychotropic Drugs	Choice RT Sequence
1	43	F	-	O.P.	-	-	248
2	19	F	-	1/52	-	Yes	824
3	26	M	-	2/52	Yes	Yes	482
4	30	F	-	6/52	-	-	842
5	29	M	8 years	12/52	-	Yes	824
6	32	M	7 years	2/52	-	-	482
7	33	M	10 years	1/52	-	-	428
8	36	M	5 years	1/52	Yes	-	284
9	18	M	-	1/52	-	Yes	284
10	21	M	-	2/52	-	Yes	428
11	18	M	18/12	1/52	-	-	248
12	22	F	1 year	Day Pt.	-	Yes	284
13	31	M	6 years	Day Pt.	-	-	428
14	21	F	-	Day Pt.	-	-	248
15	21	F	-	1/52	-	-	824
16	18	M	-	1/52	-	-	482
17	30	F	7 years	5/52	Yes	Yes	482
18	15	M	2 years	Day Pt.	-	-	824
19	20	M	2 years	Day Pt.	Yes	Yes	842
20	29	M	7 years	1/52	Yes	Yes	842
21	20	F	3 years	1/52	-	Yes	284
22	20	M	-	O.P.	-	Yes	248
23	31	M	6 years	8/52	Yes	Yes	824
24	18	M	- -	1/52	-	-	428

APPENDIX IV

DETAILS OF RESULTS OBTAINED BY ENDOGENOUS DEPRESSIVES

(See Chapter 7)

APPENDIX IV.

Patient	Age	Sex	Treatment	H.R.S.			S.S.I.			Log R.T.		
				1	2	3	1	2	3	1	2	3
1	59	F	Drug	33	17	8	20	31	16	47.9	73.9	36.4
2	48	F	Drug	23	10	5	29	23	13	54.6	46.2	45.6
3	35	F	Drug	16	16	17	6	7	4	52.0	49.6	47.9
4	52	F	Drug	31	27	31	36	32	36	44.2	43.8	52.8
5	47	F	Drug	22	11	8	28	12	8	62.6	53.5	44.9
6	59	F	Drug	22	28	21	18	16	16	42.0	41.0	48.7
7	54	F	Drug	15	4	3	17	6	9	52.1	45.6	43.6
8	27	M	Drug	18	8	2	12	2	5	48.0	37.1	28.3
9	50	M	Drug	20	21	17	29	27	30	41.2	46.8	50.6
10	68	F	E.C.T	30	17	12	62	47	51	45.2	38,9	47.0
11	41	F	E.C.T	31	23	14	38	29	15	51.2	51.2	52.2
12	54	F	E.C.T	32	19	7	42	45	33	56.6	56.2	50.8
13	47	F	E.C.T	28	17	4	28	13	3	60.3	52.2	43.5
14	66	M	E.C.T	35	28	11	17	13	6	80.6	46.8	40.0
15	77	M	E.C.T	36	30	20	26	27	25	39.6	35.6	35.8

Scores of 15 endogenously depressed patients on Hamilton Rating Scale, Sympton-Sign Inventory, and simple R.T.

(See Chapter 7).

APPENDIX V

MANIC-DEPRESSIVE PSYCHOSIS:
AN ALTERNATIVE CONCEPTUAL MODEL.

Summary of paper to appear in

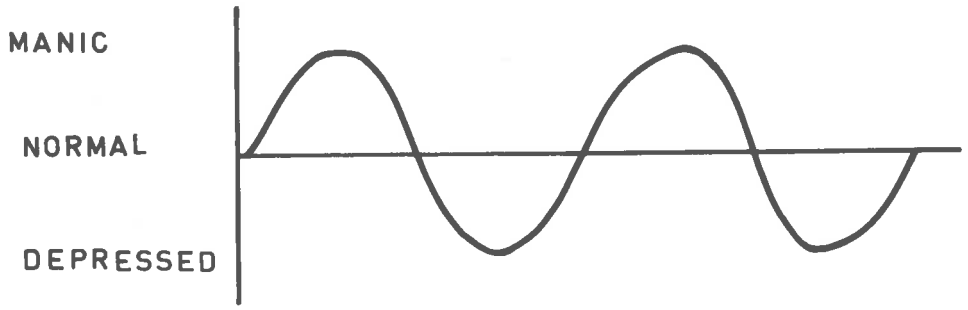
British Journal of Psychiatry, 1968. 114. 517

SUMMARY OF

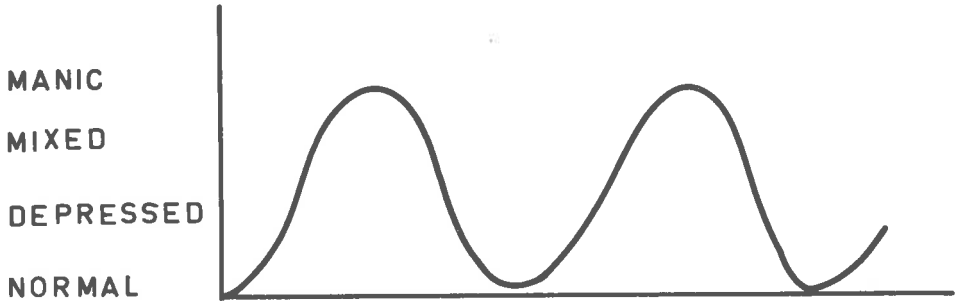
"MANIC-DEPRESSIVE PSYCHOSIS: AN ALTERNATIVE CONCEPTUAL MODEL."

In 1967, Schou wrote "We may still lack...a proper model of the manic-depressive patient". The traditional bi-polar model has a number of conceptual difficulties associated with it. It always implies that normality is to be found between two extremes. The less extreme form of the psychosis is seen in the normal with a cyclothymic temperament who is considered to move above or below some arbitrary normal level. While it is clear that symptomatically, manics and depressives are in many ways opposite, it does not necessarily follow that polarity offers the best conceptual model for the psychosis itself.

A more helpful concept would be that of a continuum with normality at one end, mania at the other, and depression in an intermediate position (Figl A.1). On this basis the earliest indication of affective disorder would be depressive while the more extreme reaction would be manic. The dynamic view of mania as a defence against depression has conventionally implied that mania is an opposite, i.e. polar, response defending against deep depression. Without denying the behavioural truth of this, the continuum model would imply that it is not until depression has progressed to an intolerable intensity that the new defence is invoked. Adoption of the continuum model would require the treatment of mania to be seen in a different light and certain paradoxical aspects of current



THE BI-POLAR MODEL



THE CONTINUUM MODEL

FIG. **A1** ALTERNATIVE CONCEPTUAL MODELS OF MANIC-DEPRESSIVE PSYCHOSIS .

treatment could be rationalised.

The following observations relating to manic-depressive psychosis are more consistent with a continuum model than a bi-polar one.

(i) The transition

If mania and depression are opposites then a move from one to the other would demand a period of normality during the transition. Although normal periods are often observed, it is also common to observe a very rapid shift from one to the other (especially from depression to mania). Under these circumstances, it is easier to consider the manic episode on a continuum with depression but even further removed from reality.

(ii) The mixed state

The same argument applies to an understanding of mixed states in manic-depressives. If a polarity hypothesis is adopted, co-existing features of mania and depression should balance out to produce an essentially normal picture. It is, however, well-recognised clinically that the mixed state is one of truly psychotic intensity, requiring urgent treatment.

(iii) Response to added stress

The onset of both manic and depressive reactions commonly follows a significant traumatic event or time of stress. It is possible to argue that when a normal person encounters trauma he will either become depressed (the most common reaction) or will defend against this with a manic reaction. Under these circumstances

polarity could offer an appropriate conceptual framework. But when a person who is already depressed suffers further trauma, it is difficult to envisage a shift across to the opposite pole through normality. It is easier to envisage a deepening of depression to such a degree that an alternative reaction is necessary if life is to be preserved, so the manic defence is invoked.

(iv) Use of E.C.T.

If mania and depression are at opposite poles, then treatment should be opposite in character to bring the patient back to normality. Yet prior to recent specific drugs, it was common practice to control manic reactions with several E.C.T. given at closely-spaced intervals - the very same treatment used for depression, except that with the latter the frequency is usually less. The frequency of administration of E.C.T. usually offers some clue to the extremity of the psychotic state. It is therefore entirely consistent with a continuum hypothesis that a depression should receive E.C.T. while a mania should require more intensive treatment of the same type.

It is often asserted by clinicians that a danger in giving E.C.T. to a manic-depressive patient when depressed is that it will precipitate a manic episode, i.e. the patient will "go too far the other way" due to E.C.T. One may alternatively suggest that what really happens is that the therapist has failed to halt the progress of the illness which proceeds into mania in spite of rather than because of treatment. The failure to hold an affective psychosis

in check is more readily identified when drugs are used and have to be increased repeatedly before therapeutic changes are obtained.

(v) Anti-manic drugs

The treatment of mania by lithium is now well established yet Adreani, Caselli and Martelli (1958) report using Lithium alone to treat a series of 24 depressed patients with good results in 10 of these. Baastrup and Schou (1967) have reported the use of lithium in the manic phase of the manic-depressive psychosis, and have used it prophylactically together with antidepressants to counter depressive episodes. To use an anti-manic drug in the treatment of depression would be paradoxical if the two conditions were considered to be polar.

The other drug now widely used in the treatment of mania is Haloperidol (Serenace). Yet in a symposium devoted to the use of this drug, concern was expressed by contributors (Tewfik 1965) at the appearance of depressive reactions which then responded to E.C.T. Following the continuum model these reactions would be both expected and a welcome indication of a movement towards a normal mood-state.

(vi) Use of antidepressants

A continuum hypothesis makes it rational to treat both mania and depression with the same form of therapy. In addition to using supposedly an antimanic drug in depression, there is also evidence that an antidepressant can be of benefit in mania. One

anecdotal account by Schou (1963) favours this interpretation, since a depressed patient who became hypomanic was kept on anti-depressant therapy (imipramine) and the mania disappeared after five days. Schou (1963) also refers to the report of Akimoto, Nakakuki and Machiyama (1960) using imipramine saying that they "made the unexpected observation that cases of typical endogenous mania responded well to the drug." The adoption of a continuum model could encourage further investigation of the interchangeability of anti-manic and anti-depressant therapies. If the model is correct, it should be possible to use lithium or an anti-depressant interchangeably in cases of true manic-depressive psychosis.

(vii) Biochemical findings

The results of biochemical studies vary widely. Some would be difficult to reconcile with the bi-polar concept but readily fit in with a continuum hypothesis. Coppen (1965) offers data relating to the exchangeable sodium on 23 depressed and 13 manic patients and concludes "that manics show the same shift in residual sodium as do depressives but with a more extreme departure from normality; the indications are that as far as sodium metabolism is concerned mania and depression represent similar conditions."

(viii) Prodromal signs

It might be argued that the continuum model does not easily account for those patients who move directly from normality into hypomania or mania. According to this model one would expect an intervening period of depression. It is, however, well known that

many patients recognise prodromal symptoms of approaching hypomania- commonly these include features such as increased sensitivity, irritability and sleep disturbance. These may well be interpreted as a transitory depressive equivalent prior to the more serious reaction.

(ix) Declining incidence of mania

Many older clinicians report that manic episodes are seen much less frequently than twenty years ago. It is difficult to be sure how far this is true, and how far, if it is true, it is the result of changes in psychiatric management. A report by Lachman and Abrams (1963) has detailed the incidence of manic illness encountered at Bellevue Hospital, New York in the years 1948-1962. A dramatic decline is apparent especially between 1948 and 1952. Possible explanations such as changes in diagnostic nomenclature and the introduction of major tranquillisers were discussed but the conclusion drawn was that no single causal factor could be demonstrated.

With the traditional bi-polar model it is difficult to explain this change. However, with the continuum model one would predict that therapies directed to the effective treatment of manic-depressive depression would result in a reduced incidence of mania also. The use of E.C.T. was not discussed by Lachman and Abrams, but it was certainly being used increasingly in the 1940's. Consequently one would expect a high perdentage of patients who previously developed manic episodes, to be treated with E.C.T. before reaching the more extreme reaction and therefore the incidence of manic illness would be reduced. In contrast, one would expect an increase in the

diagnosis of manic-depressive illness, depressive type, but this would not necessarily be represented in any statistics available due to the advent of anti-depressant drugs. Any tendency for the incidence of depression in the psychiatric hospital to rise, would be offset by the increasing use of out-patient and general practitioner facilities. This is evident in Lachman and Abram's report which reveals a steadily declining total admission rate for the entire period.

(x) Early psychological studies

Psychological test data using simple reaction time (R.T.) measures have long shown (Bevan-Lewis 1899, Lundholm 1922, Wulfeck 1941) that hypomanics perform more slowly than normals, contrary to the 'common-sense' expectation that they would be able to make rapid responses. If the relationship between mania and depression were a bi-polar one, then results from each could be expected to be impaired to an equivalent degree. If, on the other hand, the continuum model is correct, then the responses of hypomanics and manics should, as a group, be slower than those of depressives, and both groups slower than normals. This proved to be the case in an early study by Lundholm (1922).

(xi) Present findings on simple R.T.

The performance of manic-depressive patients was compared with performance of normal subjects on simple R.T.

The number of subjects in each sample is shown in Table 1.

Normals		Manic-Depressives			
		Depressed		Elated	
M	F	M	F	M	F
6	6	8	8	4	5

Table 1 - Composition of samples of patients and normals

The performance of the three groups is shown in Fig. A.2. The patients were tested shortly after admission to hospital. These trends give support to the hypothesis that elated patients are more severely ill than depressed patients who suffer from manic-depressive psychosis.

The possibility that the hypomanics were slow on R.T. for reasons different from the depressives was considered. It might be thought, a priori, that the distractibility of the former and the retardation of the latter could account for poor performance. A strong argument for discounting this possibility was provided by the pattern of pre-preparatory interval (P.P.I.) scores. By using irregular P.I.s it was possible to examine the effect of the preceding stimulus, or P.P.I. This has been shown by Zahn, Rosenthal and Shakow (1963) to be significantly affected in schizophrenics as a result of their inability to maintain set. A similar situation was found with both hypomanics and depressives (see Fig. A.3). The pattern of disturbance in the two phases of manic-depressive

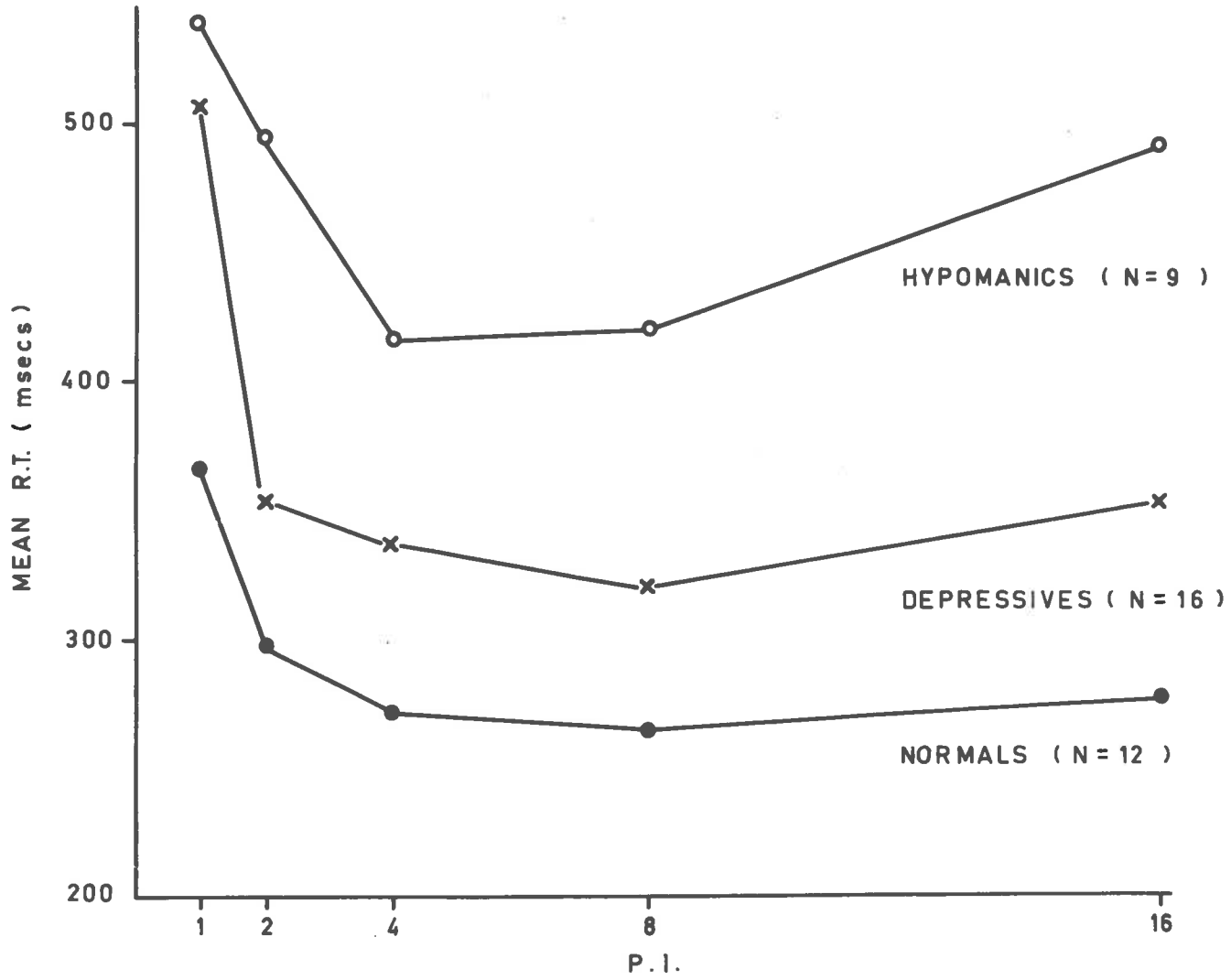


FIG. **A 2** THE PERFORMANCE OF MANIC-DEPRESSIVES AND NORMALS ON SIMPLE R.T. WITH IRREGULAR P.I.

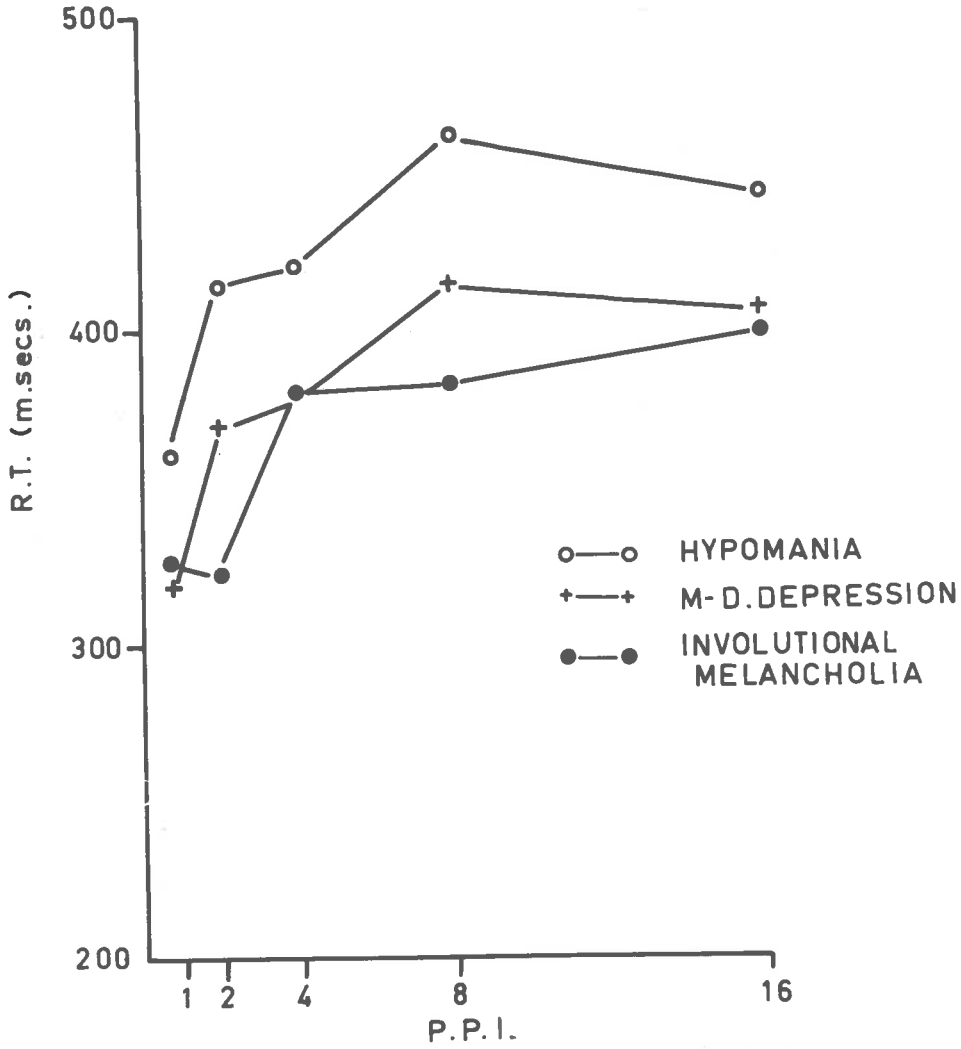


Fig. **A3** THE EFFECT OF P.P.I ON SIMPLE R.T. IN AFFECTIVE PSYCHOSIS .

psychosis is indistinguishable but the relative levels bear the same relationship as with P.I. i.e. with hypomanics slower than depressives.

The study which remains to be done to confirm this continuum hypothesis is the repeated testing of a group of patients at different points along the continuum, including if possible responses made during the mixed state.

Conclusions

Taking the foregoing review of clinical findings, together with the psychomotor work reported here and elsewhere, the most parsimonious interpretation is that manic-depressive psychosis should be conceived as a reaction in which the depressive component constitutes the first level of breakdown, while mania is the more severe condition. In no way does such a proposal cut across the concept of a cyclic psychosis, but it does put the components of the cycle in a different relationship from that which has been traditionally proposed or implicitly assumed. A continuum hypothesis makes the mixed state more comprehensible, and offers a rationale for the use of the "normothymotic" drug lithium in both manic and depressive phases. Hitherto the occasional successes have been obtained paradoxically rather than rationally. It would also revolutionise clinical practice in relation to patients receiving treatment changing from one phase of the continuum to the other. Treatment would not be discontinued or changed as is usually done but maintained.

The traditional emphasis on polarity has arisen because behavioural indicators have been paramount in identifying the progress of manic-depressive psychosis. The more recent evidence from biochemical studies and drug response make it clear that behaviour cannot be assumed to be the best guide for the clinician. When it comes to decisions regarding therapy it is doubtful whether these polar observations deserve the attention they have tended to receive - the progression along a continuum from normality is more likely to offer therapeutic rewards. It is therefore important to distinguish between symptomatic aspects of manic-depressive psychosis in which opposite responses are observed, and the syndrome itself where a continuum away from normality is observed.

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APPENDIX VI

RELEVANT PUBLICATIONS.

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