

RARE BOOK

REACTIONS TO STRESS AS A FUNCTION
OF THE LEVEL OF INTELLIGENCE.

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by

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ABSTRACT

An attempt to examine the relation between certain cognitive reactions to stress and the level of intelligence of subjects exposed to the stress was made in the present research. Stress was experimentally produced through the application of the insoluble problem technique. Two hundred and thirty-one school boys, divided into six experimental and four control groups, acted as subjects. Their selection was made on the basis of scores on a group verbal intelligence test. The intelligence quotients of the subjects ranged from 77 to 137 and their chronological ages, from 112 to 141 months.

In a preliminary experiment, 20 other children were used to determine the relative difficulty of two soluble problems and the nature of transfer effect from one to the other. This information was useful in the planning of the main research.

The following hypotheses were examined in the main experiment.

First, that the effect of stress on a subsequent learning task is positively related to the level of intelligence of the person stressed;

Second, that the degree of stereotypy in behaviour under stress is inversely related to the level of intelligence of the person stressed;

Third, that stress tends to interfere with the transfer effects of a previously learned task; and, Fourth, that the effects of stress increase directly with the degree of stress.

The research design provided the use of three different experimental situations under each of which the effects of two degrees of stress were studied. The first situation had two soluble problems, one before and one following the trials on the insoluble task. The two problems were RRL and LLR referred to as first and second soluble problems, respectively. The other two situations had only the second soluble problem following trials on the insoluble task, with the difference that knowledge of failure on the insoluble task was given the groups in the second experimental situation but not those in the third. Two experimental groups served in each of the three experimental situations. Out of the four control groups, two served as controls for the experimental groups in the first experimental situation and two for the experimental groups in the second and third experimental situations.

The results obtained showed no evidence for a significant or systematic relation between the level of intelligence and reactions to stress. There was only partial evidence for the prediction that the effect of stress on subsequent

learning increases directly with the level of intelligence. There also was only slight evidence that stress interferes with the transfer of training from one learning task to another. However, there was significant difference between post-stress learning when exposure to stress was preceded by learning and when it was not. The latter showed greater effect of exposure to the insoluble task on subsequent learning.

These results have been discussed in terms of young chronological age and a general orientation with the experimental situations. A few suggestions for further research in this area have also been given.

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CHAPTER I

Introduction

Experimental studies of behaviour under stress gained considerable impetus from the conditioning experiments of Pavlov (50) and researches on psychopathological behaviour since then have become increasingly extensive. At first, such experimental studies were mainly devoted to investigations with infra-human animals, but were soon extended to include human subjects. A majority of these studies have concentrated primarily on emotional reactions to stress as evidenced both in psychological and physiological variables. There are, however, a few studies concerned with the effects of stress on skilled performance, perception and memory. The present research was designed to examine the relations between certain cognitive reactions to stress and the level of test intelligence of the subjects exposed to the stress.

In the literature the concept of "stress" has most often been defined in terms of situational or organismic variables (3, 10, 47, 58). The limitations of both these approaches have been pointed out by Lazarus et al (34), Rao (53), and Moghni (46). In view of the fact that both these types of definitions only partially describe the phenomena observed, some investigators (34) have been led to propose another

definition of stress as an intervening variable built upon the relationship between motivation and the situation in which a powerful motive is thwarted (34). While there is nothing amiss theoretically in defining stress in such a way, it is certainly against the law of parsimony to introduce an intervening variable unless it is essential. To do so in the case of "stress" is not unavoidable because it is possible to define the concept operationally in terms of observable stimulus-response dimension. Russell (41) has proposed such an operational definition in terms of behavioural homeostasis. He borrows the concept from physics and translates it into behavioural terms. The organism is continuously maintaining homeostatic balance against the impingement of environmental forces and hence there goes on a continuous process of adjustment between the organism and the environment. During this process adjustive changes in the organism tend to keep the homeostatic balance intact. There is a limit to the organism's capacity for such adjustive changes, and when this limit is exceeded, behaviour becomes disorganized. The disorganization may be temporary or may persist for an extended period of time.

"Frustration" and "conflict" in the above formulation are sub-concepts which serve as critical conditions under which behavioural homeostasis is difficult to maintain and a disorganisation in the adjustive process occurs. "Frustration"

refers to a situation in which the organism is faced with some obstacle beyond its capacities to surmount, and "conflict" to a situation involving the presence simultaneously of two or more incompatible response tendencies.

Physiological correlates of stress are sufficiently documented by the researches of Cannon (6), Selye (64), and others. Cannon defines homeostasis as a "condition of stability which may vary but which is relatively constant". Resistance to changes induced by external stimulation as well as to disturbances from within is an evidence of the adaptive stabilising processes within the organism. Selye's "general-adaptation syndrome" describes the same sequence of behaviour which either leads to adaptation or to "diseases of adaptation", depending on the interplay of the intensity of a stressor and the tolerance-threshold of the organism. The general-adaptation-syndrome has three successive phases; alarm reaction, stage of resistance, and stage of exhaustion, all of which can be observed in the physiological state of the organism.

Stress, then, in this context of behaviour-theory can be defined as "those conditions which give rise to interference with behavioural homeostasis", the definition to be used in the present study. A frustration situation has been used to study reactions to stress. Reactions to stress are defined as the behaviour

changes in the organism exposed to stress. Such behaviour changes have been measured in terms of the number of trials to learn a soluble task following exposure to an insoluble task. Other secondary measures likely to show behaviour changes in the subjects as a result of stress have also been recorded. These include the number of errors on the soluble task, stereotypy, and latency, duration, and amplitude of responses. Intelligence for the purposes of this research refers to the performance of the subjects on a group verbal intelligence test, Pidgeon's Primary School Verbal (Group) Intelligence Test I.

Reactions of children of different levels of intelligence to two degrees of stress have been studied. The following specific hypotheses were formulated for empirical examination:

First, that the effect of stress on a subsequent learning task is positively related to the level of intelligence of the person stressed;

Second, that the degree of stereotypy in behaviour under stress is inversely related to the level of intelligence of the person stressed;

Third, that stress tends to interfere with the transfer effects of a previously learned task; and,

Fourth, that the effects of stress increase directly with the degree of stress.

CHAPTER 2

Historical Background

For the last three decades studies of behaviour under stress have been a focal point in psychological research. Extensive investigations have been reported on emotional reactions both in terms of psychological and physiological variables. From a survey of the literature such studies seem to have followed two main lines of methodological approach. One, the clinical approach frequently has taken the Freudian theories as its frame of reference. Researches within this model have mainly followed a therapeutic line of attack and have concerned less with the scientific accuracy and objective reliability. The second has employed the rigors of scientific logic and experimental method. Pavlov's (50) production of "experimental neurosis" in the dogs gave real impetus to the study of reactions to stress and led to increased experimentation with animals as subjects. Many excellent surveys of such studies exist in literature (9, 38, 40, 45).

The present chapter outlines the relevant researches on conflict and frustration conducted using human subjects. The first section will deal with studies employing cognitive functions as dependant variables. The second section will

This introduction is intended to give a brief outline of the general approach the present research has taken. The next chapter will deal in some detail with the historical background of the problem in the light of which the present research may be evaluated.

CHAPTER 2

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The present chapter outlines the relevant researches on conflict and frustration conducted using human subjects. The first section will deal with studies employing cognitive functions as dependant variables. The second section will

cover propositions concerned with relations between intelligence and reactions to stress.

A. Experimental Studies of Reactions to Stress.

The first studies of conflict in which Pavlovian conditioning technique was employed with human subjects were carried out in 1907 by Krasnogorski (32) using the motor reflex of the opening of mouth as the conditioned reflex. Many ingenious methods of producing frustration and conflict have been reported since then. One of the most widely-used methods, which has been given prominence by Maier (40) and his co-workers, is the "insoluble problem" technique which they have applied primarily to infra-human animal subjects. The first study to use this method with human subjects is reported by Marquart (42). Using college students as subjects, she studied the pattern of punishment and its relation to abnormal fixation. In a preliminary experiment the subjects had to learn a complex discrimination habit, then were exposed to an insoluble situation, and finally were required to learn a simple position-habit. In the main experiment the original learning situation was omitted. Errors were always punished with electric shocks. The results were interpreted as confirming Maier's (40) contention that frustration-instigated behaviour is qualitatively different from goal-motivated behaviour. She also found the evidence of extreme rigidity, or what Maier calls "abnormal fixation", in her subjects.

Kay (28) compared the reactions of delinquent, maladjusted and control groups of adolescent boys to frustration produced by motivating the subject to find, blindfolded, the solution to an insoluble finger-maze. The results indicated that the maladjusted group showed the greatest signs of disorganisation of behaviour, with the delinquents next. The delinquents and the maladjusted also showed lower capacity to withstand frustration than did the control subjects.

Jones (25) also employed an insoluble problem situation to produce frustration in an attempt to study its effect on learning. He gave three durations of frustration with two degrees of motivation to 144 subjects and found that an immediate disorganisation of behaviour occurred as a result of the frustration. However, under conditions of prolonged stress frustration a point was reached after which further frustration did not lead to a further increase in the time taken to learn the subsequent problem or in the degree of stereotypy.

Moghni (46) using an insoluble problem situation with 12- to 14- year old children attempted to study the effect of duration of exposure to stress and the length of time for recovery from its effect. He found no significant effect of stress on their subsequent behaviour. No significant differences were found by varying the duration from 10, 50,

100 to 150 trials on the insoluble task and the length of the time for recovery from 10 seconds to two, four to six minutes.

Russell and Steinberg (62) in a recent study on the effect of nitrous oxide on reactions to stress employed the insoluble problem technique using college-students as subjects. They found that after 50 trials of the insoluble problem, the experimental subjects took significantly greater trials to learn a soluble task than the control group. They suggest that their results might be accounted for in terms of transfer of training from one task to another as well as in terms of reactions to stress.

The studies discussed above are characterised by an uniformity in the stress to which subjects were exposed and are relevant to the present study only in so far as there is this methodological similarity. The studies to follow are characterised by a diversity of approach, but derive their relevance to the present one by the fact that in all intellectual functions in one form or another have been studied under conditions of frustration or conflict.

Very early in 1927, Sullivan (70) reports a study wherein two separate series of experiments were conducted to investigate "...attitude in relation to learning". Her subjects included children, adolescents and adults. The first series of experiments had to do with purely intellectual type of attitude and the second with attitude of a type likely

to have emotional accompaniments. In both series of experiments the attempt was to afford suitable problems for learning and discover changes which accompany differences of attitude on the part of the subject. Summarizing the conclusions with reference to "emotional failure and success" attitudes, she stated that with adult subjects the time taken to learn a memory-series was greatest with the knowledge of previous failure and that the same was true for relearning following the failure. With adolescent subjects, knowledge of failure increased and knowledge of success decreased the time taken to learn. The success made more significant changes with the latter group than the failure. Her findings on the relation of the differences in response to failure or success to differences in intelligence provide support for the present study. Of two groups of adults of "high mentality" and of adolescents of "low mentality", the adults were affected by failure more than the adolescents. Her interpretation of this finding was quite in line with the assumptions of the present research. She suggests that high mentality subjects are more accustomed to and therefore less affected by success; while they are less accustomed to and therefore, appreciate the meaning of failure. Low mentality subjects are more accustomed to and appreciate less the meaning of failure. The only noticeable difference due to chronological age was that with adults the changes in attitude were less persistent than with children.

In another group of subjects of the same chronological ages and of the same social group but being again separable into low and high mentality, Sullivan reported that the greatest difference in learning was with the high mentality group working with the knowledge of failure. With the low mentality group the results were just the opposite. The change noted with the failure report in the high mentality individuals is greater than the change with the success report in the low mentality group. The high mentality group is, therefore, more active or sensitive in its reaction to failure and low mentality group to success.

Lantz (33) in a research designed to determine the effect of success and failure on mental, verbal and personality-responses of nine-year old boys, gave Revised Stanford-Binet Form L and M before and after a ball-game on which half the boys succeeded and the other half failed. Other variables were carefully controlled and the effects of success and failure were thereby isolated as far as possible. In the ball-game situation the boys were to secure a ball from a box three times in three different ways. She found that the experience of failure on the ball-game served as a depressant on the post-failure performance, significantly inhibiting the expected average test-retest increase in response, and decreased significantly the number of correct responses to the items involving thought-processes. Failure also produced

significant behavioural changes reflecting tension and a desire to leave the failure-situation hurriedly. It resulted in verbal expressions of "need for ego-preservation" and of physical tension. The experience of failure was related to excess activity and also to a decrease of the average ratings of socially important traits. In general, Lantz found that the experience of failure caused a greater decrement in mental processes than the experience of success caused an increment.

Lazarus and Eriksen (35) report an experiment where the effect of failure threat upon the performance of college students on Wechsler-Bellevue digit-symbol sub-test was studied. Two groups of 115 and 73 students served as experimental and control subjects, respectively. After the Form 1 of the digit-symbol test was administered to both the groups, the experimental subjects were informed that they had done very poorly on the test, and therefore another test would be given to them to make sure that their true ability had been measured. It was emphasized that their performance might be used as information to their faculty concerning their status in school. The control subjects on the other hand, were told that they had done very well, but in order to ascertain that their true ability had been measured, more measurements would be made. They were urged to improve their performances on the second test. The two groups then were given Form 2 of

the digit-symbol test in a lengthened version. The results indicated that " ... the effect of stress upon performance varies with the individual. The performance of some subjects under stress is little affected whereas other subjects show large improvement or decrement." They also found that subjects with high grade point average showed improvement in performances under stress while those with poor academic standing did poorly and were more variable.

The famous study by Barker, Dembo and Lewin (3) provides a detailed analysis of verbal, motor and emotional behaviour of children, before, in and following a frustration-situation. Thirty children between the ages of two and five years were observed individually while playing with a standardised set of toys in a "free-play" and a frustration situation. Frustration was produced by putting a wire-barrier between the subjects and highly attractive toys. These toys were kept visible all the time but were made inaccessible to the children. The subjects' Intelligence Quotients ranged from 100 to 157. The authors hypothesised that regression should show itself not only in the action towards the inaccessible goal, i.e. in the constructiveness of the play, but also in behaviour not related to this goal. The atmosphere was made as natural, free and spontaneous as possible. They found that correlation between mean constructiveness of play in

the "free play" situation and the mental ages was 0.73. This relatively high correlation indicates that constructiveness of play is a function largely of the level of intelligence. There was a significant regression of constructiveness in the frustration-phase, which suggests that frustration affected an impairment in the level of functional intelligence. For ten younger subjects, regression was smaller than for twenty older subjects. Under frustration the richness of play-activity decreased and there was an increase in stereotypy.

This study is an important contribution to the reasoning underlying the present problem. The general conclusions from it are helpful in formulating further hypotheses for testing:

First, that rigidity is inversely related to intelligence and is aggravated in a frustration situation,

Second, that the quality of behaviour suffers a deterioration due to frustration. There is, however, in certain cases an increase in the quality of performance.

Third, that it is possible that the effectiveness of frustration may increase directly with chronological age.

Wright (78) reports a study in which constructiveness of play was investigated under conditions of frustration and group-organisation. Frustration was produced by a modified Barker-Dembo-Lewin technique. Seventy-eight children of

3 to 6 years of age were divided in 18 pairs of strong friends and 21 pairs of weak friends to study the effect of "social atmosphere" surrounding the child. Two experimental sessions, free play and frustration, were employed. Constructiveness of play was measured by the time spent in the situation and the quality of the play was arbitrarily classified into four levels of constructiveness. Wright reported a statistically significant decrease in constructiveness for the group as a whole under frustration. The relation was consistently maintained with an increase in the strength of frustration. He also found statistically significant decrease in constructiveness for both the pairs of strong and weak friends. This shows that the effects of frustration on the intellectual level of the child was too great to be counter-acted by the security of the social atmosphere. This was an ingenious attempt to study the effect of frustration upon intellectual level as exhibited by play-activities in a social setting. As indicated earlier, constructiveness of play is highly correlated with the intelligence level of the child.

Ross, Rupel and Grant (59) reported a study of abstract behaviour under various types of stress: "impersonal distraction, personal heckling and physical threat of electric shock". Abstract behaviour was defined in terms of scores on the Wisconsin Card-Sorting Test. The W.C.S.T. consisted

of 60 response cards each of which could be sorted for colour, number or form under four stimulus cards. No cues were given except that each card sorted was called right or wrong. One hundred and sixty college-students acted as subjects in a tri-factorial design. The results showed that impersonal distraction and personal heckling had no effect on the subjects' abstract behaviour. Electric shock was the only stress-condition which caused a statistically significant deterioration in performance on the test. The deterioration of performance was of a general nature and the recovery from the effects of the shock was surprisingly rapid.

Davitz (11) conducted an experiment with 10 groups of four subjects each to test the hypothesis that "aggressively-trained" and "constructively-trained" subjects will behave with greater aggressiveness and constructiveness respectively, after a period of frustration produced by interrupting an interesting movie show at the climax, and snatching away candy-pieces from the hands of the subjects coupled with stern orders to go to another room and play. The subjects were studied in a free-play situation first, and then a period of training on constructiveness or aggressiveness followed. After training the subjects were put in the frustration situation following which another period of free-play was provided. The results confirmed the hypothesis. The author concluded that previous training in situations similar to that

in which frustration is encountered is a significant determinant of the organism's post-frustration behaviour. Previous training must be considered in the understanding of post-frustration behaviour.

In another experiment, Brower (5) tried to determine the correlations between intelligence and cardio-vascular measures, i.e. diastolic blood-pressure, pulse-rate and pulse-pressure, in a visuo-motor conflict situation. Forty-eight undergraduates acted as subjects on Snoddy mirror-drawing task under the conditions of direct vision, mirror vision and the blindfolded state in that sequence. The intelligence quotient was determined through the use of the Wechsler-Bellevue Adult Intelligence scale. The relations were found to be consistently inverse in the pre-experimental phase. This general trend was maintained in the post-experimental phase for pulse-pressure. For the other two measures, the correlations were statistically insignificant. The subjects' superior intelligence tended to be able to operate in the experimental situation without generating the cardiovascular excitation that those of average intelligence would tend to exhibit. However, Brower commented ... "It may very well be that the disorientive character of the visuo-motor experimental task constitutes an influence which far outweighs the limiting value which superior intelligence exerts upon cardiovascular activity prior and/or after the Snoddy task." This is the only study of its kind,

but the need for further researches in this direction is recognised by the author.

Foulds (18) after an attempt to discover a dominant reaction-pattern among forty-five mental defective juvenile delinquents on Rosenzweig's (58) classification of subjective reactions to frustration concluded that those making "impunitive" reactions tended to be less intelligent and less stable than the other two frustration-types, i.e. "intrapunitive" and " ". By implication this conclusion, although based on a very small number of cases, supports the view that low intelligence and emotional instability are positively related.

Valentiner (76) carried on a research to determine the comparative fatiguability of normal and mentally defective children. After matching the two groups adequately, he gave a number of tests "... calculated to measure best the amount and rate of fatigue ..." both physical and mental. He found that in mental performance the mentally deficient subjects were clearly inferior to the normals in both accuracy and amount accomplished. He also noted that the "... amount and weight of onset of fatigue in mental work was greater in the case of the mentally deficient as was indicated by greater decrement in their speed and accuracy and the greater accumulation of blocks".

In a series of experiments on the influence of relative frequency of successes and frustrations on intellectual

achievement, Thorndike and Woodyard (73) induced failure in College undergraduates and educated adults by requiring them to do their best on a long series of tasks, none or only a small percentage of which could be completed within the time allowed. In one experiment 30 subjects over 18 years of age worked with a long easy and long hard series of tasks. Success occurred in about one-fourth of the easy series and in about one-twentieth of the hard series. Comparing the achievements of subjects on the two series of tasks, they found that there was some impairment in learning when the mind was suffering and had been suffering very frequent failures. Learning was reduced by about one-eighth by the greater frequency of failures.

Theisen and Meister (71) in a laboratory investigation of measures of frustration-tolerance of pre-adolescent children, report that the mental age and Intelligence Quotient both correlated positively with frustration tolerance, suggesting that brighter children have a higher degree of tolerance.

An objective investigation of the reactions of human subjects to a frustrating situation is reported by Zander (79). He created an insoluble situation which required them to learn a series of numbers that had increasing lengths and difficulty until they became unexpectedly unable to learn the series which were shorter than those already learnt. The numbers

were presented one at a time every three seconds by lighting one of the five numbers pasted to the glass front of a box. As the number series increased, they were made more complex and more difficult. Each subject was brought to the laboratory for four consecutive days. The fourth day the series were made non-learnable. He gives a detailed analysis of behaviour of the subjects under the experimental condition. However, two aspects of this analysis are relevant to the present discussion. He separated the subjects into superior and inferior scores on the factors of maturity, relation of personality development to physical growth, intelligence, emotional stability, and ratings on extroversion-introversion scale. The most typical behaviour during frustration was then determined for each extreme group from the behaviour ratings of each subject. On comparing the two groups, Zander found that the inferior group in these measures "... is typified by either regressive or inattentive behaviour or both. The superior subjects used aggression more frequently than did the inferior ones. Aggression was more closely related to attention in the pattern of behaviour." Another comparison involved the division of the subjects into two extreme groups of eight each on the basis of their intelligence-levels. The higher intelligence group had a mean Intelligence Quotient of 137.1, and the lower, of 100.5. The higher group showed a significantly greater degree of participation in

cooperative behaviour than the lower group, while the less intelligent group had a higher percentage of participation in defensive, withdrawing, and non-adjustive behaviour. Co-operative behaviour differentiated most clearly between the two groups. It was interesting to note the instigation to aggression among subjects who preferred attentive behaviour. This result emphasises the need for recognizing that aggression is not essentially an abnormal and non-adjustive reaction to frustration. These results lend support to the assumptions that persons of higher intelligence are more aggressive, more attentive, less stressed and, therefore, less susceptible to frustration than those of lower intelligence. They are also more stable, less apathetic, more co-operative, and less non-adjustive in a stressful situation.

Seashore and Bavelas (63) using children as subjects produced frustration through Goodenough Draw-a-man Test. The subject was asked to draw the picture of a man. Every time he finished one drawing, another blank sheet of paper was given with the same instructions. This procedure was continued till the subject either refused to draw or had drawn as many as 15 pictures. Satiation, experimenter's implied disapproval, and need for social approval were the sources of frustration in this study. They found a decrease in the mental ages of the children in most cases, although in a few there was a gain also. On the whole, there was a general trend towards a decrease in the cognitive abilities. Commenting on the

results they pointed out that frustration affects the productivity and intellectual ability of the subject. It may increase or decrease the cognitive abilities.

O'Conner (48) in a study of psychological stability and anxiety-aggressiveness administered a battery of tests to a group of high-grade male mental defectives and found that those who could be rated as anxious tended to be less intelligent, more susceptible and clumsy than the more aggressive ones. This conclusion is in line with Zander's results.

There have been but few studies exclusively designed to study specific cognitive functions under stress. Memory and relearning have received the most attention; however, two researches discussed in the following pages, have studied the effect of stress on perception and on rational behaviour.

Postman and Bruner (52) studied perception under stress. They divided ten subjects into experimental and control groups, and presented them with 18 three-word sentences using a modified Dodge Tachistoscope. Subjects were required to report everything they saw or thought they saw. In the initial series of nine sentences both the experimental and control groups were treated identically: subjects were asked to continue their judgement until they had reported each sentence in turn correctly. After the initial series the

experimental group was exposed to a perceptual frustration by the quick presentation of a highly complex picture at low illumination. In addition, the subject was told that it was of utmost importance that he be very attentive to instructions if the study was to be effectively done. Bitter comments and reports of sub-standard performance followed every attempt of the subject. Control subjects received a much more pleasant treatment at the end of their initial series. In a third phase nine more sentences were exposed to both the groups, with the difference that the experimental group had to perceive it at a sub-threshold speed. To this were added bitter and disparaging remarks from the experimenters. The performances of the two groups were compared in the third phase of the experiment. It was found that perceptual behaviour became disrupted, disintegrated, and "reckless" under stress. Even the process of exploration which is a preliminary condition of all perception, suffered under stress. It was noted that behaviour became less adaptive and less well-controlled and that the major dimensions of perceptual function were affected. There was mal-adaptive accentuation in the direction of aggression and escape.

Patrick (49) used Hamilton's classification of reaction-tendencies in a study of rational behaviour to determine the frequency of various responses to the experimental situation. Hamilton (22)'s classification

included five types of reaction-tendencies ranging from the highest "rational inference", type A, to the lowest "primitive tendency to repeat the same activity", type E. A multiple-choice situation with an ever-varying-unlocked-door principle of a rational nature was used. The emotional stimuli used for the study were electric shock, cold shower, and loud continuous blast of a horn. A control group was employed for comparison purposes. A pre-experimental phase in which both the experimental and the control groups had to undergo a 10-day period of 100 trials, was followed by another 10-day period of 100 trials in which the experimental group was subjected to one of the emotional stimuli. Nineteen college-adults were used as subjects. Patrick found that, under conditions of emotional stimuli, the rational quality of behaviour deteriorated greatly. Some subjects, manifesting Type A reactions predominately under normal conditions, manifested a predominance of Type E reactions under stress. There was a marked reduction of efficiency in the quality of the reaction-tendencies and a significant increase in activity while exposed to the emotional stimuli.

Interrupted Task

In addition to these investigations, there have been a few studies concerned with the tendency to continue an interrupted task which have a bearing on the present research.

Rosenzweig (56) gave two simple jig-saw puzzles to a group of 37 children. The group succeeded on one but failed on the other. After the experiences of success and failure, it was found that the older children preferred to repeat the puzzle on which they had experienced failure, while the reverse was true of the younger subjects. There was a clear relationship between the type of choice and chronological age. On the basis of a "pride-rating" Rosenzweig discovered that the older children seemed much more conscious of the fact that they were being tested and showed more external signs of tension. One factor related to the repetition-preferences was mental age, a highly significant co-variation of these two factors being found. The relation between mental age and repetition-preferences was more marked than that between chronological age and repetition-preference.

In another experiment, designed to determine whether successful or unsuccessful activities are more apt to be remembered, Rosenzweig and Mason (57) found that the group which recalled successes better was differentiated from the other group by a more advanced average mental age and a higher average "rating of pride". The results of this study were interpreted in the light of conclusions from the previous experiment. The authors suspect that the same factors which made for choice of successful puzzle for repetition also made for preferences in recall of the unsuccessful task.

Following on Kopke's (36) experiments on the resumption of interrupted tasks by the feeble-minded and normal subjects Rethlingshafer (54) conducted a series of experiments. In one experiment the behaviour of feeble-minded and normal subjects of equal mental ages was compared in the "tendency-to-continue" following interruption of activities on eleven different tasks. In all the different tasks, interruption was at a standard place for all subjects, approximately when one-half the original activity was completed. Seventeen different types of behaviour following interruption were converted into a normal scale ranging from high to low scores on tendency-to-continue. The two groups exhibited the same types of behaviour. The feeble-minded did not have any greater goal-fixation. Following these results, Rethlingshafer (54) again devised another experiment to find out whether feeble-minded and normal subjects could be differentiated in their behaviour following an interruption when first, a substitute was offered to the subject in place of the original activity on which he was interrupted, and, second, when such a substitute was not provided. A substitute meant another similar activity provided in place of the original one. She found that in the presence of a substitute, the tendency to continue the interrupted activity decreased for both groups. An increase in similarity between the original

and substitute activity was not effective in consistently decreasing resumptions by the normal subjects. When physical barriers of various types were set up so that the subject could not resume the interrupted activity, both the groups were affected, the feeble-minded being more affected than the normal.

In a third experiment (55), the behaviour of the fifty-eight children previously tested was compared with the behaviour of a superior adult group of forty-one college students. The comparisons emphasized behaviour of these three groups following interruption of a task. Rethlingshafer found no differences in the types of behaviour exhibited by the three groups. The correlation between intelligence and persistency of behaviour on being interrupted was not significant.

The results of these experiments contrast with those of Kopke's (36) analysed by Lewin in his discussion on feeble-mindedness. The only difference in the procedure of the two experiments is the fact that in the latter, the mental ages of the subjects were equated. The difference in the results therefore suggests that it is the difference in the mental ages of the respective groups which may determine the type of behaviour following the interruption of a goal-motivated activity. Given equal mental ages, no significant differences appear between the behaviour patterns of these groups. These results suggest the conclusion that intellectual level is an

important factor in determining the reaction-patterns of individuals subjected to this variety of stress.

Rigidity of Behaviour.

There is another aspect of the general problem under discussion which concerns rigidity of behaviour under severe frustration and conflict. Rigidity is defined as the constant repetition of a mode of behaviour which has ceased to be adequate in a particular situation. A number of researches on rigidity of behaviour under stress exist, a few of which will be reviewed here.

Kounin (31) prompted by an attempt "... to evaluate the concept of rigidity, to develop methods of measuring its properties and to ascertain its validity in theories of age and feeble-mindedness..." devised a series of experiments wherein he put to test five derivatives from Lewinian concepts of rigidity and feeble-mindedness (36). Three groups of subjects of equal mental ages, old feeble-minded, young feeble-minded and young normals, served as subjects in experiments on "...satiation-co-satiation, transfer of habit, card-sorting in simple and overlapping situations, integration by classification and re-structuring by classification." The first experiment provided each subject with four different drawing activities to determine the degree of communication from one drawing to another. The general plan of the second experiment was "...to create a specific situation for each

subject, to place the subject in another situation, and to note what effect Situation-1 had upon the subject while he was in Situation-2 - i.e., to determine the degree to which the subject was in an overlapping situation." The first situation was to depress a lever to release a marble and the second, to raise instead of to depress the lever, to release the marble. Each subject was given three series of 30 trials each in the first situation and two series of thirty trials each in the second. The third experiment was "... to determine the ratio of the difficulty each subject had in the performance of a particular activity in a simple situation to the difficulty he had in the performance of the same activity in a more "complex and more overlapping situation". Card-sorting in four situations, three simple and one complex, was the activity utilized. The procedure in the fourth and fifth experiments was to present each subject with a group of objects and to ask him to arrange them in classes or categories. In the fourth, a packet of 25 cards was used for classification, first, into five colour categories and then into five form categories. In the fifth, a group of cards with the same colours and forms as in the fourth, was given to each subject to see if he could make a change from one type of classification to the other while using the same group of cards. He claims to have obtained differences between each of the three groups with respect to the hypotheses examined. His general conclusions

are to the effect that "... any performance which requires a certain degree of communication between neighbouring regions is to such an extent made difficult for the old and more feeble minded person, the task might be of a cognitive motor or volitional nature."

Cowen (10) demonstrated that increase in stress produces a corresponding increase in the rigidity of problem-solving behaviour. Stress was defined in terms of the subjects' perception of "threat to his self-esteem", and rigidity was measured with Luchin's Einstellung technique (39). Three groups of 25 subjects each designated as control, mild stress and strong stress groups were used. The results showed that the control group performed the task significantly less rigidly than the mild stress group and the latter less rigidly than the strong stress group.

Ainsworth (1) produced stress with the Einstellung formula by emphasising the "speed of performance", by adding competition to the "speed of performance" and by adding individual demonstration before critical audience to the "speed" and "competition". His "additive stress" groups were exposed to these three conditions and a control group was included for purposes of comparison. He found that while there was a marked difference in problem-solving rigidity between the control and three stress groups, the differences between the stress groups themselves were relatively small.

Commenting on the results he stated: "It seems very probable that there is a tendency for cumulative stress to result in increased rigidity and that this tendency is masked in the present experiment by the fact that the added units of stress were not large enough to yield significant increases in rigidity."

Fisher (17) in an attempt to study patterns of personality rigidity used three distinct groups, normal, conversion hysterics and paranoid schizophrenics of 20 female subjects each. The subjects' intelligence quotients ranged from 95 to 110 points. The rigidity was measured in terms of performance on a rigidity battery representing "... a scatter of situations ranging from those in which the subject deals only with very simple stimuli and a limited number of alternatives, to those in which the subject deals with very complex stimuli and multiple alternatives." Each subject was given the verbal section of the Wechsler-Bellevue Adult Intelligence Test and Rorschach test before the administration of the rigidity battery. Finally, the subjects were required to fill the Guilford SIDCR. Fisher found that in general conversion hysterics and paranoid schizophrenics were more rigid than normal subjects, although there were no clear differences between conversion hysterics and paranoid themselves. No clear relations between test intelligence and the character of an individual's rigidity pattern was

found. Commenting on the findings, Fisher stated, "... it appears fruitful to conceive of rigidity behaviour as correlated with a series of "defense levels" in the personality structure. The degree and character of the rigidity shown by an individual in dealing with a given situation seems to vary in proportion as that situation poses a threat or raises serious adjustment demands."

B. Relation Between Intelligence and Reactions to Stress.

Previous researches have demonstrated that under conditions of conflict and frustration the organism sooner or later suffers a disorganisation in his behaviour, which may be transitory or permanent depending on the intensity of the stimulus and the capacities of the organism exposed to it. Intelligence has been identified with adaptability to novel situations, resourcefulness and capacity to deal with difficult and frustrating situations. It seems reasonable, therefore, to hypothesize that certain relations may exist between intelligence and reactions to stress. It is possible, for instance, that reactions to stressful situations would be relatively more stable and less rigid in more intelligent than less intelligent subjects. The former also may possess greater capacity to withstand such situations and thus to be less susceptible to disorganisations of behaviour. Clinical studies of mental patients provide some evidence for the emotional instability and maladaptive social behaviour of the less intelligent. Impairment in mental capacities due to

extreme stresses have also been noted.

The general notion that intelligence is a contributing factor in emotional stability is borne out by a number of studies. Clarke (8) found that all aspects of motor disturbance were negatively correlated with intelligence measured by Mill Hill Vocabulary Test. Kanner (26) emphasised the role of emotional system of the organism in the causation of mental deficiency. The extensive studies of Terman et al (72) into the personality of the gifted children reveal that as a group they are definitely superior in emotional stability. In order to ascertain if this characteristic is lost as a result of maturity, an elaborate follow-up was conducted seven years after the original study. The superior group again exhibited the same superiority in emotional stability and social adaptability.

Pollock (51) on the basis of statistics obtained on mental illness in New York concludes, "... We are now in a position to state positively that in general, rate of incidence of mental illness is higher among subnormal persons than among the general population and our data indicate that the rate of mental diseases declines as the degree of intelligence advances." He argues that mentally defective are poorly equipped to withstand stresses of unusual character and have difficulty in resolving their mental conflicts. Sherman (65) also points out that the number and complexity of conflicts are related in some ways to the degree of intelligence.

There are a number of studies dealing with the deterioration of general intelligence during mental illness. Simmins (66) investigated the deterioration of g-factors in psychopathic individuals. He demonstrated that both the incidence and the amount of g-deterioration are associated with the degree of illness. Solomon (69) studied the cognitive aspects of deterioration in mental patients in an attempt to ascertain certain facts concerning the nature and amount of mental deterioration. Comparing three pathological groups in a variety of specific problem-situations, he found that the capacity-level of the pathological groups was significantly lower than that of the normal in every situation.

The assumptions made so far with respect to the relations between intelligence and behaviour under various types of stress are supported by experimental and clinical observations and it seems reasonable to propose that the nature of a person's reaction to stress may partly be determined by his level of intelligence. Another hypothesis may be suggested regarding the relation between intelligence and post-stress behaviour. A highly intelligent person may not be easily stressed, but once he is stressed he may show relatively greater deterioration in the quality of his behaviour than a less intelligent person. Although there are not many experimental studies to support this hypothesis, some

theoretical reasons may be given for it. It may well be that a highly intelligent person would take a frustrating situation as an affront to his intelligence as a result of which his later reactions might be affected. He may show greater concern over his failure than one to whom failure is a more common experience in life. Sullivan's (70) study mentioned before supports this assumption.

Another theoretical support comes from the studies of Kounin (31) on feeble-mindedness and rigidity. He found that rigidity was a function of lower intelligence and advanced chronological age. Rigidity is referred to as that "property of a functional boundary which prevents communication between neighbouring regions" of the persons' mental structure. The more rigid the boundary, the less one region affects neighbouring regions. Rigidity represents the relative independence of different regions. A person of lower intelligence has a greater independence between various regions of his mental structure, and communication between these is relatively more difficult. A further analysis shows that if one region of the mind is affected by a certain frustrating experience the effect may be localised, and may not easily spread to other regions. In the more intelligent and therefore, less rigid person on the other hand, this communication between various regions is easier. The same situation which produces a

localised effect on a person of low intelligence, may have a generalised effect on the more intelligent. Arguing on these lines the more intelligent person is supposed to enter the post-stress situation with a greater effect of the stress.

The above assumption may not hold in the stress-situation itself because all the dynamics of the situation on which we base our hypothesis, do not come into operation unless frustration has actually been experienced. Throughout the duration of the stress situation the more intelligent person may feel that he is up to the occasion and, therefore, does his best to succeed. The frustration effects might be felt when ultimately he realises that he has failed. During the stress situation, he might strive hard to reach a solution and in the process may become increasingly alert; and if, after such efforts he fails, the effect may be much more aggravated.

Intelligence and Aggression.

Aggression as one of the most frequent reactions to frustration was given prominence by the Frustration-Aggression hypothesis of the Yale group led by Dollard et al (14,44). The hypothesis implied that aggression was a maladaptive reaction. The thesis of the present discussion is that aggression may also be a normal reaction to stress in certain situations. There are studies to support this point of view (79, 80).

In a round-table discussion of aggression, Zilboorg (79) argues that "... aggression like fear is a normal biological factor. It is one of the most powerful drives and it finds a perfect outlet in our culture." On this basis, it seems quite plausible to suggest that more intelligent persons may readily show aggressive tendencies when their path is blocked. Mowrer (47) thinks that aggression energises the behaviour in progress which has the distinct biological unity of tending to overcome the frustrating barrier and thereby clearing the path to the goal.

Our general observations about the behaviour of a bright child is that he is brimming with energy and is more active and imposing, whereas a child of comparatively lower intelligence is slow and submissive as if he is conscious of his inferior endowments and therefore cannot afford to show off his aggressiveness. He may have a greater tendency towards repressing his anger and irritation. O'Conner (48) found that those whose behaviour was aggressive under failure or frustration were generally found to have higher intelligence quotient. Tredgold (74) noted that among feeble-minded individuals "... submissiveness is more common than assertiveness. It is seen as a persistent timidity and shrinking and also in the usually ready recognition of and conformity to authority." Binet and Simon (4) observe that "... when the defective child becomes subject to discipline he does

not rebel, for he is obedient and respectful and probably suggestible." It seems reasonable to propose that in the persons of low intelligence aggression is easily inhibited by a feeling of insecurity and by anticipation of punishment (23). It might, therefore, be expected that in the bright person inhibition of aggression would be less frequent because, due to his superior gifts, he feels confident and secure.

Intelligence and Rigidity.

Rigidity of behaviour is another commonly-noted reaction to obnoxious and stressful stimuli. This phenomenon has other names like "fixation" or "stereotypy of behaviour". Many of the studies of behaviour under stress found evidence of rigid behaviour in their subjects (3, 39, 42, 49). Rigidity implies a phase of behaviour where an inadequate response is repeated incessantly. It is a fixated, non-variable and random attempt to get out of a difficult situation. In its extreme stages rigidity has been referred to as "abnormal fixation" by Maier (40) and his co-workers. On the basis of studies on problem-solving rigidity, it might be suggested that low intelligence has a very direct relation with rigid behaviour. Cattell and Winder (7) point out that "...rigidity is a function of many factors in which one major factor is low intelligence."

From the above discussion it appears that intelligence may be one of the critical conditions in reactions to stress.

It is important to test these hypothetical relations empirically. The present research encompasses such an attempt.

CHAPTER 3

Research Design and Procedure

The present research was designed to study reactions to two degrees of stress as a function of the subjects' level of intelligence. Stress was produced experimentally through the application of the insoluble-problem technique. The following hypotheses were formulated for examination:

First, that the effect of stress on a subsequent learning task is positively related to the level of intelligence of the person stressed;

Second, that the degree of stereotypy in behaviour under stress is inversely related to the level of intelligence of the person stressed;

Third, that stress tends to interfere with the transfer effects of a previously learned task; and,

Fourth, that the effects of stress increase directly with the degree of stress.

A. Research Design

The research design used in the present research is shown in table 1. It required 10 groups of subjects, six serving as experimental and four as control groups. By suitable comparisons of these groups it was possible to test the hypotheses proposed above.

Table 1
Research Design

Groups		Phases			
E-1	Preliminary Training.	Soluble Problem, RRL.	Rest Period One week	Insoluble Problem, 50 trials	**Soluble Problem, LIR
C-1	"	"	"	----	** "
E-2	"	"	"	Insoluble Problem, 100 trials	** "
C-2	"	"	"	----	** "
E-3	"	----	----	Insoluble Problem 50 trials	** "
C-3	"	----	----	----	"
E-4	"	----	----	Insoluble Problem 100 trials	** "
C-4	"	----	----	----	"
E-5	"	----	----	Insoluble Problem 50 trials	"
E-6	"	----	----	Insoluble Problem 100 trials	"

* Dashed lines indicate that the group concerned received no treatment during this phase of the design.

**These groups were informed that a different problem was to be presented. Groups E-5 and E-6 received no such instructions.

B. Subjects

Two hundred and thirty-one subjects, divided into 10 groups were treated as shown in the research design. They were selected from the upper grades of four junior primary schools on the basis of Pigeon's Primary School Verbal (Group) Intelligence Test I. Their chronological ages and intelligence quotients are shown in tables 2 and 3, respectively.

All subjects were boys from a north western district of London. Almost all the children were from a low, but homogeneous economic group. Most of their parents were employed as manual labourers or casual semi-skilled workers. In socio-economic status they could be classed as belonging to the lower sixth or seventh class of the Hall-Jones' (21) grading of occupations.

Matching of Groups. All the groups were matched on chronological age, sex, educational grade, and socio-economic status of parents. In addition it was decided to match the groups on their Intelligence Quotients. The initial scheme for matching was to select ten subjects of the same or roughly the same Intelligent Quotients, and allot them randomly to each of the ten groups. Adherence to this scheme was possible for only 77 per cent of the first four groups.

This procedure could not be continued because all subsequent subjects were not available at any one time for testing. Therefore, a new procedure was adopted which

Table 2Chronological Ages of the Subjects
in Months

<u>Group</u>	<u>N.</u>	<u>Mean</u>	<u>Median</u>	<u>S.D.</u>	<u>Range</u>
E-1	23	125.7	127.0	5.27	115-133
C-1	22	124.6	125.0	4.88	115-132
E-2	23	124.1	124.0	5.01	114-133
C-2	22	126.1	127.0	4.91	116-133
E-3	23	131.3	131.0	6.26	116-141
C-3	23	130.4	133.0	8.45	114-140
E-4	24	130.3	131.0	5.91	117-139
C-4	23	129.8	132.0	5.35	117-140
E-5	24	129.8	131.0	7.58	112-140
E-6	24	132.1	132.0	4.95	124-141

Table 3Intelligence Quotients of the Subjects

<u>Group</u>	<u>N</u>	<u>Mean</u>	<u>Median</u>	<u>S.D.</u>	<u>Range</u>
E-1	23	105.7	103.0	12.31	84-137
C-1	22	104.4	102.5	10.48	84-122
E-2	23	106.2	106.0	10.19	91-124
C-2	22	106.3	106.5	10.37	86-124
E-3	23	108.4	109.0	12.85	79-129
C-3	23	108.0	109.0	14.12	78-129
E-4	24	108.3	107.5	13.29	85-131
C-4	23	107.9	108.0	14.10	81-135
E-5	24	108.2	106.5	14.50	82-134
E-6	24	107.5	107.5	13.66	77-131

involved dividing the whole range of the Intelligence Quotients of available subjects into five or six narrow ranges, then to pick up as many Intelligence Quotients as groups from each range, and to allot them randomly to each group. A table of Random Numbers was used for the purpose. It was not always possible to have the required number of Intelligence Quotients in each narrow range. In such cases this narrow range was extended to find subjects for each group. This procedure was repeated thrice during the course of the experiment. The fact that the groups were matched on the Intelligence Quotients is borne out by the results of a Distribution-free K-sample test against ordered alternatives carried out on the number of trials to learn the first soluble problem, RRL. The result gave r quotient of rank correlation equal to 0.126. In this test "... the closer r is to unity, the more the sample data are in conformity with the ordered hypothesis alternative to that of randomness." (24).

Motivation. Motivation of the subjects was given special attention. Each subject was promised a monetary reward of one penny for each pattern successfully completed during phases 4 and 5. A special prize was also announced, to be given to those subjects who were the quickest in finding the pattern. In addition, every subject was told that the Headmaster would like to see how the boys did in the experiment and, therefore, the boy should do his best to please the Headmaster by finding the pattern as quickly as he

could. Classroom teachers were requested to ask the boy to go to the experimenter; sometimes the Headmaster himself sent the boy to the research room. This was to emphasise to the boys the interest the teachers were taking in the experiment. Each subject also was told that the experimenter had been to other schools, that boys of the same age and Form as the subjects did very well on the tasks, and that their results would be compared with those of boys from the other schools. Some evidence of high level of motivation on the part of the subjects to win the monetary rewards was noted during the experiment. Voluntary statements like, "Johnny told me that the man has brought a machine which gives out money", were quite frequent. The following questions also illustrate this point:

"You get a penny every time you get a white light ?"

"Anybody else got it right ?"

"It won't be counted, will it ?" - for practice trials.

"Will I get the penny if I get the buzz ?"

"Is there ?" - after the special prize was announced.

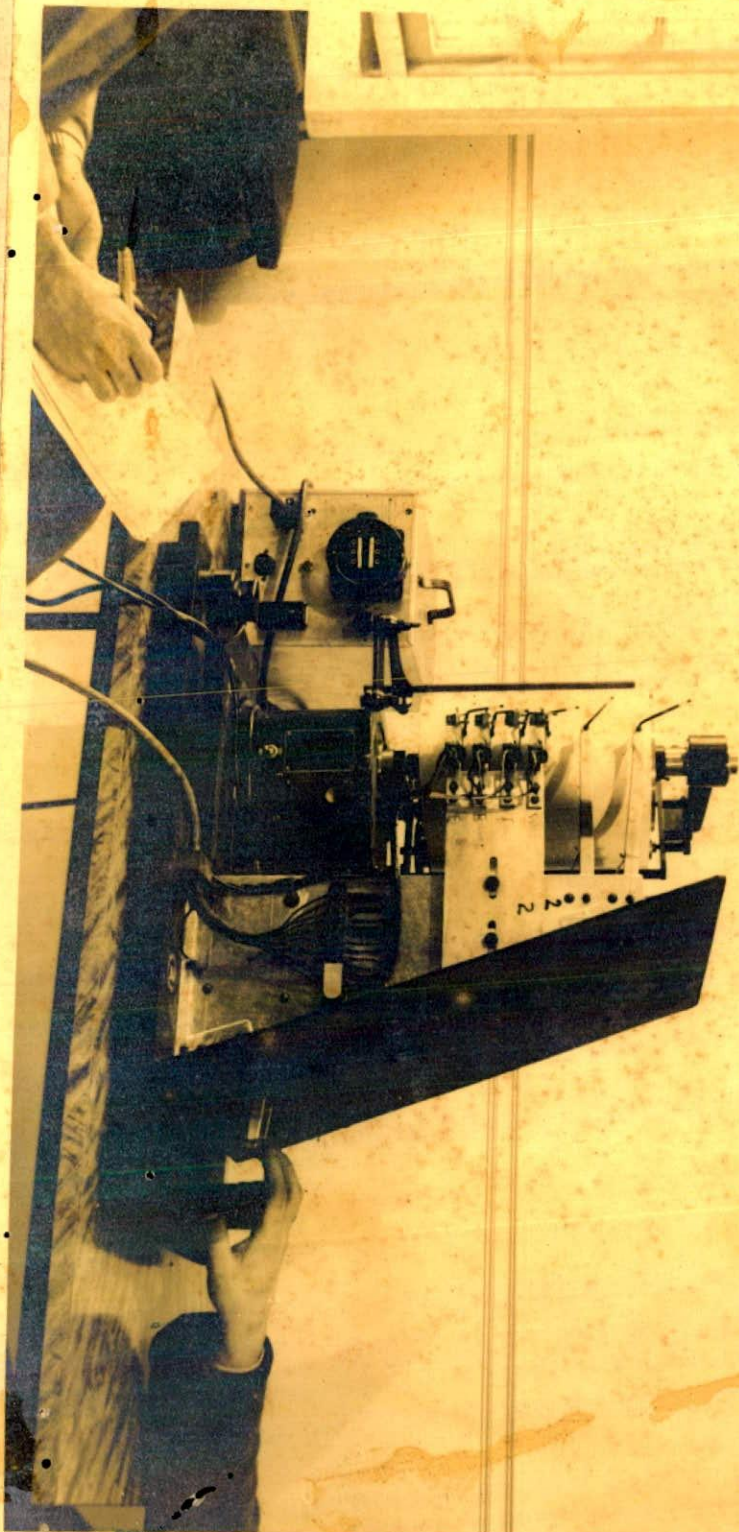
It was so arranged that subjects with lower Intelligence Quotients were the first to be tested. Each time the next subject came, he was told that the last boy did quite well.

C. Apparatus.

Figure 1 shows the apparatus used in the present research. It contained two response keys, protruding from

FIGURE 1

Picture of the Apparatus employed in the Research



a vertically-mounted black screen which hid other parts of the apparatus in order to prevent distraction. On the screen were mounted two light signals, one red and one white, and an auditory signal, a buzzer. The signals were individually connected with the main part of the apparatus behind the screen by means of electric circuits and were controlled by mechanically operated switches, which could be set in predetermined sequences by the experimenter. The red light went on at regular intervals of five seconds; each appearance indicated to the subject that he must respond by pressing one of the keys. Immediately after pressing, the white light replaced the red if the response was correct, and the buzzer sounded if it was incorrect. The period between the two red lights was constant, but the actual time for which the white light and buzzer signals were on, depended upon the speed of the subject's response.

The one insoluble and two soluble tasks presented to the subject were of the nature of a temporal maze. The insoluble task contained a sequence of twelve pressings of the right and left keys and started anywhere in the following series:

RLRLRLRLRL, "R" referring to right key correct and "L" to left key correct. When switched on, the apparatus kept repeating the complete sequence. The length of the sequence made it impossible for the young children to learn it in the time allowed and, therefore, constituted an "insoluble" task. The other two tasks were much simpler. In the first, the right key had to be pressed twice successively and then the left key once. Henceforth this task will be referred to as the "RRL" problem. In the second task, the left key had to be pressed twice in succession followed by one press of the right key. This will be referred to as the "LLR" problem.

Six different features of the situation could be traced on an ink-recording polygraph. These included responses of the subject on the left and right keys, correct or incorrect responses indicated to the subject by the appearance of the white light or by the sounding of the buzzer; time-record showing the appearance, for four seconds, and disappearance, for one second, of the red light signal; and excessive pressure exerted on the key. The apparatus also contained a counter which indicated the number of trials administered and the number of errors made. This was useful in administering the required number of trials on the insoluble task and also in ending the experimental session when the criterion of leaving the soluble tasks had been reached.

D. Procedure

Instructions. After a short period spent in gaining rapport with the subject and making sure that he was comfortably seated, the following instructions were read to him:

"I am going to ask you to find a pattern. Do you know what a pattern is? Can you make a pattern? Here are a few counters of different colours. Can you make a pattern in colour? Can you make a pattern in sound? Will you try? Can you make the same pattern in lines? Will you try again? (The making of the patterns was demonstrated by the experimenter.)

So now you can see for yourself that a pattern is where the same order is repeated over and over again. Now I want you to discover a pattern in pressing these two keys. (The experimenter pointed to the response keys.)

Put your two fingers on these two keys. Look at that glass-cover. There will be a red light (demonstrated by the experimenter). Immediately you see the red light, press one of the two keys. Wait until the red light comes back again for the next pressing. If you press the correct key, there will be a white light (the experimenter showed the white light), but if you press the wrong

key, you will hear a buzzer (the experimenter again demonstrated). So you know that the white light means a correct answer and the buzzer means a wrong answer. Do you follow ?

Now if you find the correct pattern quickly, you will get a penny as a prize. And if you discover it very quickly, you might be able to win a special prize which I will give to the boys who are the quickest at finding the pattern. Do you understand ?"

After the instructions were fully explained the subject was given a 30-second practice period on the apparatus, after which the following questions were put to him to make sure that he followed the instructions and knew what he was going to do:-

When will you press the key ?

How will you know that you have made a mistake ?

How will you know that you have made a correct answer ?

How many keys do you press at any one time ?

How often must you press the key after each light ?

What are you going to find out ?

Fine, now let us see how quick you are in finding the pattern. Are you ready ? Now, go."

Beyond this point the procedure differed slightly for the various groups. For Groups E-1 and E-2 twice in the 4th

and again in the 5th phases, and for Groups C-1, C-2, E-3 and E-4 in the 5th phase the following instructions were added and specially emphasised.

"This time I am going to give you a different, entirely changed pattern from the one you had last time. Remember that this is an entirely different pattern. There is again a prize of one penny and the special prize for discovering this pattern also. Let us see how soon you find out this new pattern. Ready, go."

Preliminary Training. Before starting the main experiment and after the instructions were fully explained, each subject was given a 30-second practice period on the apparatus. The insoluble task was used for the purpose. Any questions regarding the procedure outlined in the instructions, were answered by the experimenter.

First Soluble Problem - RRL. Groups E-1, C-1, E-2 and C-2 were required to learn the first soluble problem, RRL. These groups were used to study the effects of exposure to the insoluble task on transfer of training.

Period of Rest. After the RRL problem, one week's rest was given to the subjects of Groups E-1, C-1, E-2 and C-2. They were not told that they would be needed again.

Insoluble Problem. As is shown in table 1, Groups E-1, E-3 and E-5 were given 50 trials and Groups E-2, E-4 and E-6,

100 trials each on the insoluble task. This procedure made it possible to study the differences in reactions to two degrees of stress.

Second Soluble Problem-LLR. All ten groups were required to learn the second soluble problem, LLR, in the final phase of the experiment. For Groups E-1 and E-2 it was the third task preceded by learning RRL and 50 and 100 trials on the insoluble task, respectively. For Groups E-3 and E-4 it was the second task, preceded by 50 and 100 trials on the insoluble task. For Groups C-1 and C-2 it was also the second task preceded by learning the RRL problem. For Groups C-3 and C-4 it was the first learning task. For Groups E-5 and E-6 there was no separation between 4th and 5th phases and, therefore, from the subjects' point of view it was also the first learning task. The soluble problem LLR was switched on for groups immediately after their 50 or 100 trials on the insoluble task. The subjects were given no indication that the situation had changed and to them it was a continuation of the problem in the 4th. phase. Groups E-5 and E-6 were included in the research design to study the effects of distinguishing insoluble and second soluble problems. No time lapsed between the 4th. and 5th. phases except what was required in giving the additional instructions to Groups E-1, E-2, E-3 and E-4.

Learning Criterion. For both the soluble problems, RRL and LLR, the learning criterion was six correct repetitions of the pattern, i.e. 18 consecutive errorless responses. As many trials were allowed as were needed for solution up to a maximum of 250. Each appearance of the red light signal was counted as a trial even if, as happened in some cases, the subject failed to make a response.

CHAPTER 4

Preliminary Experiment : To Determine the Relative Difficulty of the Soluble Problems and the Nature of Transfer Effects From One to the Other.

This preliminary experiment was designed to study the relative difficulty of problems RRL and LLR and the nature of any transfer effects from one to the other as measured by the number of trials to learn the second. These two problems were to be used as soluble tasks for the main experiment. A detailed description of the problems and the apparatus used to present them to the subjects has been given in the preceding chapter.

Research Design and Procedure.

Research design is shown in table 4 .

Table 4

Research Design: Preliminary Experiment

<u>Group</u>	<u>Phases</u>	
	1	2
A	Soluble Problem-RRL	Soluble Problem - LLR
B	Soluble Problem-LLR	Soluble Problem - RRL

Group A was presented the RRL problem and then the LLR problem, while for Group B the procedure was reversed. The instructions were the same as those used for the main experiment. The criterion for learning the problem was six

correct repetitions of the pattern. Practice was discontinued if this criterion was not reached in 300 trials in the first phase and in 250 trials in the second phase.

Subjects.

Twenty children were selected for this experiment. They were divided into two groups of 10 subjects each. One subject in Group B was absent on the day of the experiment. The procedure for assigning members to each group was to select a pair matched for chronological age, Intelligence Quotient, educational grade and socio-economic status of their parents and to assign one to each group on a random basis. Tables 5 & 6 give the chronological ages and the Intelligence Quotients of the subjects.

Table 5

Chronological Ages of the Subjects in the Preliminary Experiment

<u>Group</u>	<u>Mean</u>	<u>Median</u>	<u>S.D.</u>	<u>Range</u>
A	128.8	129.0	2.32	126-132
B	126.0	126.0	4.76	118-132

Analysis of the Learning Scores.

Table 6 presents the learning data in terms of trials to reach the learning criterion. Non-parametric statistics were used in the analysis of the data.

Table 6Trials to Reach Criterion in the Preliminary Experiment

<u>Group A</u>				<u>Group B</u>			
<u>Subject</u>	<u>I.Q.</u>	<u>RRL</u>	<u>LLR</u>	<u>Subject</u>	<u>I.Q.</u>	<u>LLR</u>	<u>RRL</u>
1	79	41	12	1	79	173	10
2	85	300	250	2	85	300	98
3	86	32	85	3	86	300	250
4	86	182	250	4	---absent---		
5	88	154	1	5	88	53	6
6	92	6	10	6	94	83	15
7	99	175	67	7	100	300	250
8	102	50	6	8	103	15	10
9	106	29	28	9	104	300	250
10	117	3	15	10	118	300	250
Mean	94.0	97.2	72.4		95.2	202.6	126.5
Median	90.0	45.5	21.5		94.0	300.0	98.0
S.D.	11.12	94.4	115.5		11.48	92.5	113.5

a. Relative Difficulties of the Two Problems

The difference between the two groups in the number of trials to learn the first problem is quite large. Numerically, nine out of 10 subjects in Group A learnt RRL while only four out of nine learned LLR in Group B. In learning the second problem as well there is a difference between the groups. Significances of differences between the medians, using the chi-square test, were computed for the groups on the number of trials to learn the problems in the first and second phases of the research design. Chi-square for the former is 1.210 and for the latter, 0.048. Both these values are very low and justify the conclusion that the two problems are not significantly different. The "Sign Test" (Table 10, Dixon and Massey, p.324) between the number of trials to learn the problems in the first phase by the two groups is also not significant.

b. Nature Of Transfer (from one problem to the other)

There is no difference between the amount of transfer from the first to the second problem in the two groups.

Table 7 gives the percent of transfer in both the groups.

A median chi-square test between the percent of transfer in two groups yields a chi-square value of 0.048. There is, however, a slight tendency suggesting that transfer from RRL to LLR is less than transfer from LLR to RRL. There are four cases of negative transfer from RRL to LLR while there

Table 7Transfer Effects in Preliminary Experiment

	<u>Group A</u>		<u>Group B</u>	
	<u>RRL-LLR</u>	<u>Per Cent</u>	<u>LLR-RRL</u>	<u>Per Cent</u>
1	29	70.73	163	94.22
2	0	0.00	202	32.66
3	-53	-62.35	0	0.00
4	-68	-27.20	---absent---	
5	153	99.35	47	6.82
6	-4	-40.00	68	81.93
7	108	61.43	0	0.00
8	44	88.00	5	33.33
9	1	3.45	0	0.00
10	-12	-80.00	0	0.00
Median	0.5	1.73	5.00	6.82
Mean	19.8	11.34	53.89	27.66

Difference between 300 and 250 is counted as zero, because both indicate the failure of the subject to learn the pattern.

is no case of negative transfer from LLR to RRL. The "sign test", however, shows no statistical significance for the negative transfer. The transfer from one problem to the other is, therefore, significantly positive, though there is greater positive transfer from LLR to RRL. Table 8 bears out both these points. The two problems are positively related, but this relation is significantly strengthened when LLR precedes RRL. Again the correlation between Intelligence Quotients and number of trials to learn the problem is reduced in size when LLR follows RRL, but is increased in size when LLR precedes RRL.

Discussion and Conclusion

The results of this preliminary study established that the two problems RRL and LLR do not differ from each other in difficulty and that the transfer from one to the other is generally positive. This conclusion was of interest for the main research as it was decided to use the two problems as soluble tasks in the main experiment and for purposes of studying the effects of stress on transfer of training. In fact the research design of the main experiment did not require that the two tasks be of equal difficulty, but the knowledge acquired during this preliminary experiment helped in the interpretation of the final results and in the detailed planning of the procedure for the main experiment.

Table 8Rank-correlations Between the Trials to learn
and Intelligence Quotients of Subjects

<u>Groups</u>	<u>I.Q.& 1st. Problem</u>	<u>I.Q.& 2nd. Problem</u>	<u>1st.& 2nd. Problem</u>
A	-.603**	-.312	.415
B	.166	.446	.904*

* shows 1% level of confidence

** shows 5% level of confidence

* shows 1% level of confidence

** shows 5% level of confidence

CHAPTER 5

Results

The results of the main experiment will be discussed under appropriate sub-headings. Throughout the analysis non-parametric statistics have been used; such statistics were selected because of the skewed distribution of many of the behaviour measures taken which did not justify assumptions of normality. For this reason chi-square median tests and rank-correlation methods have been used. Median tests were computed to test the null Hypothesis wherever differences in performance for different groups were to be compared. Snedecor's correction for continuity (68) for chi-square was used, the formula for which is:

$$\text{Chi-square} = \frac{N(ad - bc) - \frac{N}{2}}{(a + b)(c + d)(A + c)(b + d)}^2$$

Spearman's "rho" (30) was calculated when determining the relations between intelligence and performance on the soluble tasks. Due to frequent ties in the rankings, a correction was made by the following formula (67) :

$$\text{rho} = 1 - \frac{\text{sum } d^2}{\sqrt{\frac{1}{6}(n^3 - n) - T} \sqrt{\frac{1}{6}(n^3 - n) - U}}$$

The correction for ties in general is that sum d^2 is divided by $\sqrt{\frac{1}{6}(n^3-n)-T} \sqrt{\frac{1}{6}(n^3-n)-U}$ instead of $\frac{1}{6}(n^3-n)$, where T is equal to $\frac{1}{12}[\sum(t^3-t)]$, t is the number of objects involved in one tied ranking, U is equal to $\frac{1}{12}[\sum(U^3-U)]$, and u is the number involved in the other. Table 17-6 (p.261, Dixon and Massey) was consulted to test the significance of "rho" (13). Figures in the tables marked with an asterisk reach statistical significance, which is defined throughout the chapter in terms of the five per cent level of confidence. Problems RRL and LLR will be referred to as the first and second soluble problems, respectively.

I. Effects of Stress on Learning the Second Soluble Task.

Effects of stress were measured in terms of the number of trials and of errors in learning the second soluble task. These data are shown in tables 9 and 10, and in figure 2. Table 11 shows the significance of differences between the experimental and their respective control groups. No significant differences were found between any pair of experimental and control groups, either for trials to learn or errors during learning. It is evident, therefore, that exposure to the insoluble task had no significant effect on subsequent learning under the present experimental conditions.

II. Effects of Different Amounts of Stress on Learning the Second Soluble Task.

Table 12 gives the significance of differences between

Table 9Trials to Reach Learning Criterion on the Second Soluble Problem.

<u>Group</u>	<u>Mean</u>	<u>Median</u>	<u>S.D.</u>	<u>Range</u>
E-1	52.4	12.0	77.20	0-250
C-1	38.7	8.5	54.78	0-225
E-2	42.8	21.0	49.03	0-148
C-2	70.1	42.0	80.84	0-250
E-3	100.8	75.0	85.44	1-250
C-3	122.9	73.0	94.16	20-250
E-4	89.7	51.5	88.79	1-250
C-4	70.2	38.0	70.67	2-250
E-5	109.6	100.0	81.44	5-250
E-6	114.8	66.6	92.92	3-250

Table 10Errors in Learning the Second Soluble Problem

<u>Group</u>	<u>Mean</u>	<u>Median</u>	<u>S.D.</u>	<u>Range</u>
E-1	24.9	7.0	35.89	0-125
C-1	17.8	4.0	28.92	0-134
E-2	16.3	10.0	20.44	0- 88
C-2	32.5	11.0	43.94	0-135
E-3	50.5	33.0	46.23	1-143
C-3	61.5	32.0	47.45	9-143
E-4	43.0	21.5	45.00	0-141
C-4	33.7	20.0	37.31	1-136
E-5	50.5	28.5	39.19	3-123
E-6	56.0	30.5	48.64	1-143

Figure 2

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Histograms: Frequency Distribution of
Trials to Learn the Second Soluble Problem

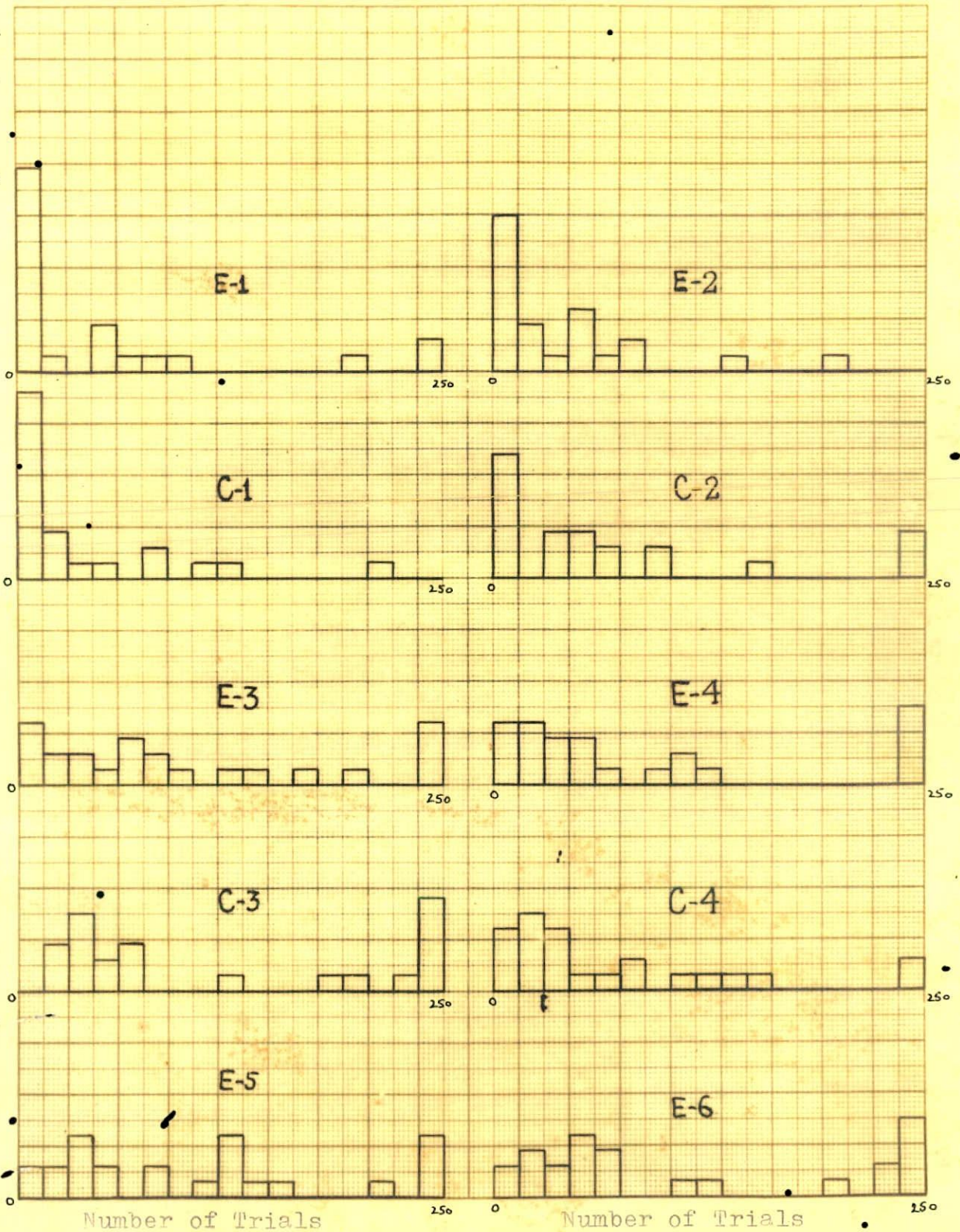


Table 11

Effects of Stress on Performances of
the Second Soluble Task - Significances
of Differences Between Experimental and
Control Groups.

	<u>Chi-square - trials</u>	<u>Chi-square - Errors</u>
E-1 vs C-1	0.023	0.210
E-2 vs C-2	0.020	0.023
E-3 vs C-3	0.086	0.019
E-4 vs C-4	0.190	0.020
E-5 vs C-3	0.190	0.020
E-6 vs C-4	1.050	1.062

Table 12

Effects of Different Amounts of Stress
on Performance of the Second Soluble
Task - Significances of Differences
Between Experimental Groups.

	<u>Chi-square - trials</u>	<u>Chi-square - Errors</u>
E-1 vs E-2	0.348	0.350
E-3 vs E-4	0.716	0.528
E-5 vs E-6	0.750	0.280

groups with 50 and 100 trials on the insoluble task. There are no significant differences which can be attributed to the effects of different amounts of stress.

• III. Effects of Stress on Transfer of Training.

The experimental situation for the first four groups, E-1, C-1, E-2 and C-2, was analogous to Woodworth's (77) Plan 2 for studying transfer of training. It was expected that the trials on the insoluble task would interfere with the transfer effects of the first soluble problem on the second soluble problem in the experimental groups, and that this interference would increase with greater number of trials on the insoluble task. Many ways of analysing transfer effects have been suggested (20). In scatter-diagrams of the numbers of trials on the first soluble problem and the gain or loss on the second in Groups E-1, C-1, E-2 and C-2, it was noted that the transfer effects were proportional to the number of trials to learn the first problem. The ratio trials on the first task minus trials on the second task divided by trials on the first task, therefore, seemed the most suitable measure of the transfer effect for the present data. The results are presented in Tables 13 and 14. Transfer effects may lie between +100 and -100 per cent. As table 15 indicates, there are no significant differences between groups. Therefore, there is no evidence that exposure to stress influenced transfer effects. The

Table 13
Transfer Effects - Trials

<u>E-1</u>			<u>C-1</u>	
<u>Subject</u>	<u>RRL-LLR</u>	<u>Per Cent</u>	<u>RRL-LLR</u>	<u>Per Cent</u>
1	84	96.55	73	100.00
2	65	54.62	242	96.80
3	24	100.00	39	100.00
4	24	72.72	170	68.00
5	238	95.20	133	53.20
6	0	0.00	44	93.62
7	-79	-100.00	63	90.00
8	168	67.20	218	87.20
9	-64	-25.60	222	88.80
10	75	100.00	222	88.80
11	150	60.00	19	86.36
12	218	97.32	16	25.00
13	136	91.89	125	95.42
14	79	91.86	-8	-88.89
15	-4	-16.00	25	10.00
16	40	16.00	13	81.25
17	17	94.44	244	97.60
18	119	96.16	-73	-83.91
19	171	98.27	26	83.80
20	57	54.81	1	12.50
21	58	95.08	20	40.82
22	2	33.33	129	51.60
23	31	36.90	-	-

M	+	70.2	+	57.12	+	89.1	+	58.09
Mdn.	+	58.0	+	72.72	+	53.5	+	85.08

Table 14Transfer Effects - Trials

<u>E-2</u>			<u>C-2</u>	
<u>Subject</u>	<u>RRL-LLR</u>	<u>Per Cent</u>	<u>RRL-LLR</u>	<u>Per Cent</u>
1	14	66.67	93	37.20
2	238	99.58	239	95.98
3	0	0.00	0	0.00
4	148	100.00	71	91.03
5	166	77.57	-30	-57.70
6	38	100.00	176	70.40
7	117	86.67	158	63.20
8	203	96.66	-50	-90.90
9	38	95.00	-16	-47.06
10	224	97.81	102	88.69
11	-86	-95.56	0	0.00
12	-10	-66.67	21	23.07
13	-44	-73.34	48	85.71
14	-137	-93.24	-243	-97.20
15	16	17.78	163	100.00
16	-52	-94.55	-14	-41.18
17	135	83.33	56	62.92
18	-8	-72.73	60	54.54
19	76	85.39	32	100.00
20	-48	-98.00	-71	-76.34
21	-76	-84.44	116	93.55
22	-25	-56.82	47	97.92
23	21	50.00	-	-

M	+	41.1	+	13.96	+	43.5	+	29.72
Mdn.	+	16.0	+	50.00	+	47.5	+	58.73

Table 15Significance of Differences Between
Transfer Effects - Trials

<u>Groups</u>	<u>Chi-square</u>
E-1 vs E-2	0.347
E-1 vs C-1	0.023
E-2 vs C-2	0.023

general trend of the transfer is positive which shows that the learning of the first soluble problem facilitated the learning of the second, despite the presence of the intervening trials on the insoluble task. Table 16 gives differences between groups with and without the learning of the first soluble problem. Most of the differences between these groups also show positive transfer effects.

It is difficult to detect the specific components of the task responsible for the positive transfer. There are, however, some cases of negative transfer in each group, it being most frequent in group E-2 which had 100 trials on the insoluble task. Table 17 gives the significance of differences in the per cent negative transfer between groups. A comparison of only the cases of negative transfer effect in each group was made. The results indicate that negative transfer is almost significantly greater in group E-2 than in group E-1 but not much different from group C-2. There is, however, a suggestion that positive transfer is greater in the control groups than in their respective experimental groups.

Table 18 shows significant negative correlations between intelligence quotient and per cent of transfer in Groups C-1 and E-2, both for trials and errors. The general trend of negative correlations seems to suggest that the subjects of

Table 16

Effects of the first soluble problem on
performance of the second - significance
of differences between the groups with
and without the learning of the first
soluble problem.

<u>Groups</u>	<u>Chi-square-Trial</u>	<u>Chi-square-Error</u>
E-1 vs E-3	3.131	3.131
E-2 vs E-4	0.193	6.223*
C-1 vs C-3	6.449*	9.830**
C-2 vs C-4	0.023	0.209

* shows 2% level of confidence

** shows 1% level of confidence

Table 17

Negative Transfer Effect-Significance
of Differences in the per cent negative
Transfer between groups.

<u>Groups</u>	<u>Chi-square (Trials)</u>
E-1 vs E-2	3.200
E-1 vs C-1	0.313
E-2 vs C-2	1.151

Table 18Rank-Correlation Between Intelligence
Quotient and Per Cent Transfer -
Trials and Errors

<u>Group</u>	<u>I.Q.vs Transfer - Trials</u>	<u>I.Q.vs Transfer - Errors</u>
E-1	-.047	-.040
C-1	-.597*	-.412**
E-2	-.503*	-.570†
C-2	.176	-.290

* shows 1% level of confidence

** shows 5% level of confidence

higher intelligence show less positive transfer and, therefore, seem more susceptible to exposure to the insoluble task. The subjects of lower intelligence quotients on the other hand, show a greater amount of positive transfer. Table 19 gives the significance of differences between cases of positive and negative transfer above and below the ^{median} intelligence quotient of the group. Here also E-2 shows a highly significant chi-square, suggesting that negative transfer effects appear in subjects above the median intelligence quotient significantly more frequently than in subjects below the median. It is interesting to note that this effect is found in the group exposed to the greater amount of stress, but not in the other experimental group.

IV. Effects of Distinguishing Insoluble and the Second Soluble Problems.

The research design provided that knowledge of failure on the insoluble task be given Groups E-3 and E-4 but not Groups E-5 and E-6. Table 20 shows that the difference in experimental treatment had little effect on the subsequent learning of these groups; the chi-square values are not significant either for trials or errors. Using Jonckheere's () distribution-free test for groups in the order of E-3, E-5, E-4 and E-6, τ coefficient of rank correlation obtained is $-.035$, which shows that the groups are independent and conform to the alternative hypothesis of randomness.

Table 19

Significance of Differences Between
Positive and Negative Transfer for
Subjects above and below the Median
Intelligence Quotient of the Groups

<u>Group</u>	<u>Chi-square-Trials</u>
E-1	0.001
C-1	0.550
E-2	5.754*
C-2	0.000

* shows 2½% level of confidence.

Table 20

Effects of Knowledge of Failure in
the Insoluble task on Performance
of the Second Soluble Task.

<u>Groups</u>	<u>Chi-square-Trials</u>	<u>Chi-square-Errors</u>
E-3 vs E-5	0.190	0.024
E-4 vs E-6	0.750	0.280

V. Relation Between Test Intelligence and Post-Stress Learning.

Tables 21 and 22 respectively present the rank-correlations between Intelligence Quotients and trials, and Intelligence Quotients and errors in learning the first and second soluble problems. Table 23 gives the rank-correlations between errors made during trials on the insoluble task and three other measures: trials to learn the second soluble problem, errors in learning it and Intelligence Quotients of the subjects in each group. The correlations between Intelligence Quotients and trials to learn the first soluble problem, although not statistically significant for all Groups show a systematic inverse relation, which supports the statement that there exists an inverse relation between intelligence and the number of trials taken to learn a task. In anticipation of this relation the hypothesis regarding the relation between test intelligence and reactions to stress predicted a positive relation between Intelligence Quotients and trials to learn the second soluble problem following exposure to stress. The prediction is not substantiated by the actual correlations obtained where except for two groups E-2 and C-2, all are negative. It is doubtful that this general trend of negative correlations could have happened by chance. Therefore, it is suggested that stress did not have much effect on the subjects. This supports the analysis of results in section I. The correlations in table 23 are neither significant nor

Table 21Rank-Correlations between Intelligence Quotient and Trials to Learn the First and Second Soluble Problems.

<u>Group</u>	<u>Intelligence Quotient vs. First Soluble Problem</u>	<u>Intelligence Quotient vs. Second Soluble Problem</u>
E-1	-.168	-.142
C-1	-.292	.253
E-2	-.487*	.356*
C-2	-.369*	-.371*
E-3	--	-.385*
C-3	--	-.311
E-4	--	-.021
C-4	--	-.201
E-5	--	-.250
E-6	--	-.288

* shows 5% level of confidence.

Table 22

Rank-Correlations between Intelligence
Quotient and Errors in Learning the
first and second soluble Problems.

<u>Group</u>	<u>I.Q.vs RRL</u>	<u>I.Q.vs LLR</u>
E-1	-.248	-.231
C-1	-.269	.276
E-2	-.500*	.285
C-2	-.478*	-.329
E-3	---	-.357*
C-3	---	-.339
E-4	---	-.199
C-4	---	-.173
E-5	---	-.252
E-6	---	-.231

* shows 5% level of confidence.

Table 22Rank-Correlations between Intelligence
Quotient and Errors in Learning the
First and Second Soluble Problems.

<u>Group</u>	<u>Intelligence Quotient vs. First Soluble Problem</u>	<u>Intelligence Quotient vs. Second Soluble Problem</u>
E-1	-.248	-.231
C-1	-.269	.276
E-2	-.500*	.285
C-2	-.478*	-.329
E-3	--	-.357*
C-3	--	-.339
E-4	--	-.199
C-4	--	-.173
E-5	--	-.252
E-6	--	-.231

* shows 5% level of confidence.

Table 23

Rank-Correlations Between Errors made During
Trials on the Insoluble Task and Three Other
Measures: Trials to Learn Second Soluble
Problem, Errors in Learning the Same, and
Intelligence Quotients of the Subjects in
Each Group.

<u>Group</u>	<u>Errors made During trials on the insoluble task vs. Errors in learning the second soluble problem.</u>	<u>Errors made During trials on the insoluble task vs. trials to learn the second soluble problem.</u>	<u>Errors made During trials on the insoluble task vs. Intelligence Quotient.</u>
E-1	.209	.188	.090
E-2	.196	.292	.219
E-3	.068	-.054	.245
E-4	.292	.244	-.013
E-5	-.122	-.076	-.282
E-6	-.239	-.266	-.098

systematic and, therefore, do not help in interpreting the results.

VI. Latency, Duration and Amplitude of Responses.

Failing to obtain any significant differences with the scores on trials and errors in learning the second soluble problem, it was decided to pursue the analysis further using secondary measures of stress. Latency, duration and amplitude of responses were measured to determine whether or not there were any indications of the effects of stress.

Latency of response in the present research was measured in terms of the distance on the polygraphic record from the appearance of the red light to the point where either the buzzer sounded or the white light appeared. The distance was then converted into seconds. Duration of response was measured in terms of the time during which either the white light or the buzzer pen was kept pressed before returning to its normal baseline. Amplitude of response was measured in terms of the extent to which each response-key was pressed. Only the first ten and the last ten responses of the insoluble and soluble problems were measured. Tables 24, 25 and 26 show the means of these measures for each group. The means of the first ten and last ten responses are given separately.

Table 24

Mean Latency, Duration and Amplitude of First Ten and Last Ten Responses in Each Group -- Phase 2.

Groups

	<u>Latency (sec)</u>		<u>Duration (sec)</u>		<u>Amplitude (mm.)</u>	
	1st Ten	Last Ten	1st Ten	Last Ten	1st Ten	Last Ten
E-1	11.20	11.45	5.72	6.64	22.42	21.97
C-1	12.66	12.90	6.92	8.20	22.13	20.77
E-2	10.67	11.09	6.60	6.68	22.51	22.27
C-2	10.78	11.84	5.48	6.84	22.28	21.63

Table 25

Mean Latency, Duration and Amplitude of First Ten
and Last Ten Responses in Each Group -- Phase 4.

<u>Group</u>	<u>Latency (sec)</u>		<u>Duration (sec)</u>		<u>Amplitude (mm.)</u>	
	1st Ten	Last Ten	1st Ten	Last Ten	1st Ten	Last Ten
E-1	11.47	12.11	7.32	7.24	22.04	21.55
E-2	11.07	12.99	6.40	7.96	22.37	21.61
E-3	8.18	8.70	5.16	5.32	22.39	21.70
E-4	9.34	10.78	5.68	6.68	22.06	20.96
E-5	9.74	10.04	5.84	6.60	22.26	21.69
E-6	9.85	10.08	5.80	6.64	22.33	21.27

Table 26

Mean Latency, Duration and Amplitude of First Ten
and Last Ten Responses in Each Group -- Phase 5.

<u>Group</u>	<u>Latency (sec)</u>		<u>Duration (sec)</u>		<u>Amplitude (mm.)</u>	
	1st Ten	Last Ten	1st Ten	Last Ten	1st Ten	Last Ten
E-1	11.60	11.57	6.56	6.52	21.44	21.74
C-1	11.68	11.61	6.84	7.04	21.43	21.30
E-2	12.27	11.41	7.08	7.00	21.56	21.74
C-2	10.63	10.67	6.20	6.52	22.15	21.34
E-3	9.39	9.40	5.64	5.52	21.58	21.68
C-3	9.93	8.98	5.48	5.84	22.28	21.66
E-4	10.13	10.63	6.24	6.52	21.27	21.13
C-4	10.14	8.54	6.12	5.44	21.00	20.60
E-5	10.62	10.65	6.52	6.40	21.63	21.59
E-6	10.73	10.63	6.24	6.08	21.28	21.28

During the trials on the insoluble task, there was a systematic increase in latency from the first 10 to the last 10 responses. There was also a slight increase from 50 to 100 trial stress groups. There is, however, no systematic trend during the learning of the second soluble problem. It may reasonably be expected that subjects should have taken less time in the last 10 responses, when most of them were close to success. Groups E-1, C-1, E-2, C-3, and E-6 show some decrease in latency. The other groups show a slight increase. Except for group C-2, there is a systematic decrease in latency from first 10 to last 10 response in the control groups as well.

The duration of responses during trials on the insoluble task also showed a general increase from the first 10 to the last 10 responses, the only exception being Group E-1 where it is roughly equal. Duration increased from the 50 to 100 trial stress groups during the last 10 responses. There is, however, no systematic trend in the following soluble task for either the experimental or control groups.

For the amplitude of response there is a systematic decrease from the first 10 to the last 10 during trials on the insoluble task. There is no trend showing any difference between 50 and 100 trial stress groups. During trials on the following soluble task, however, there is no consistent

difference between the groups.

In the three secondary measures of stress analysed above none of the differences between groups were large. However, they show a tendency for the latency and duration of the responses to increase as a result of stress. There was a systematic difference between the two degrees of stress both in latency and duration of the responses. The amplitude of the response tends to decrease with increasing stress.

VII. Stereotypy in Behaviour under Stress.

Previous researches of Maier and others (40, 39, 42, 3) have shown that rigidity or stereotypy of behaviour is one of the symptoms of frustration. On the basis of these studies it was expected that stereotypy in behaviour as a result of exposure to the insoluble task would be inversely related to the level of intelligence.

Rigidity has usually been defined in terms of repetitions of a mode of behaviour which has ceased to be adequate in a particular situation. Many ways of measuring rigid behaviour objectively have been suggested (17, 25, 39, 42). The present measure was preferred because of its greater suitability to the present data. Rigidity here was measured in terms of similar contiguous responses in a series of trials. A number of such similar contiguous responses is referred to as a "run" (13). The number of pressings on either key was counted as one run. Thus in the sequence RLRLRLRLRL there are seven runs, and in the sequence LRLRLRLRL there are six runs.

The records of the experimental groups on the insoluble task were analysed for the number of runs. They were divided into groups of 25 trials each to see if there were any trends at different stages of performance on the insoluble task. The runs for these groups were then converted into average length of run by the use of the following formula

$$\text{Average length of a run} = \frac{\text{Total number of trials}}{\text{Number of runs}}$$

Stereotypy of behaviour as defined above may appear in two ways in the present scheme of analysis. The subject could press either the same or alternate keys all the time. The number of runs in the first case would be one and in the second, 25. Both these ways of pressing could be regarded as extreme modes of stereotypy.

In the data given here, the individual scores have been omitted, and only the group means and their standard deviations are presented in Table 27. There is but little systematic change in the average length of run between the first and succeeding series of 25 trials, neither are there any appreciable systematic differences between the groups at any division of the 25 trials. Hence this measure also, in so far as it could be regarded as an adequate measure of stereotypy in behaviour, tends to confirm the results obtained through the analyses of trials and errors.

Table 27Average Length of "Runs" in Each Group of Twenty-Five Trials on the Insoluble Task.

<u>Group</u>	<u>1-25</u>		<u>26-50</u>		<u>51-75</u>		<u>76-100</u>	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
E-1	1.833	0.631	1.990	0.867	-	-	-	-
E-2	1.705	0.435	1.756	0.324	1.735	0.375	1.677	0.497
E-3	1.515	0.357	1.481	0.353	-	-	-	-
E-4	1.606	0.383	1.598	0.451	1.650	0.450	1.594	0.436
E-5	1.621	0.416	1.658	0.436	-	-	-	-
E-6	1.919	0.590	1.893	0.907	1.655	0.427	1.522	0.356

There are, however, certain individual cases in each group which deserve special mention. In group E-1, one subject with an Intelligence Quotient of 100 continued pressing alternate keys with a total score of 50 runs, although his learning of the second soluble problem was not affected. In group E-2, two subjects with Intelligence Quotients of 123 and 117 had scores of 83, and 82 respectively, out of 100 possible runs each. Both were cases of negative transfer in learning the second soluble problem. In group E-3, there were six cases in the first group of 25 trials and seven in the second whose scores were above 20 runs in each. In group E-4, two subjects with total scores of 93 and 99 runs each showed effects of this mode of behaviour in the learning of the second soluble problem. In group E-5, one subject with a score of 47 runs did not show any effect on his number of trials to learn the second soluble problem. In group E-6, one subject with 86/100 runs failed to learn the second soluble problem, while another with 91 runs showed little effect on his post-stress learning.

The above analysis of stereotypy in behaviour, failing to show any appreciable differences between groups, does suggest that there were vast individual differences. Two general trends may be noted from the individual cases. The majority of cases showing "stereotyped behaviour" during the insoluble task, either found it difficult to learn :

the second soluble problem or failed to learn it at all; and the subjects of higher intelligence levels were more often affected in their post-stress learning because of stereotypy during the insoluble task.

VIII. Reactions to Stress as Related to Chronological Age.

The main interest in the present research was to study reactions to stress as a function of the level of intelligence, the range of chronological ages of the subjects was, therefore, deliberately chosen to be narrow. Despite the limitations of this narrow range, rank-correlations were computed between the chronological age and trials to learn the first and second soluble problems for each group and are presented in table 28. The results reveal an inverse relation between chronological age and trials to learn the first soluble problem, although significance is reached only in group E-1. The correlations between chronological age and trials to learn the second soluble task also are all negative except in groups E-2, C-2 and E-4. None of the relations except in group E-1 are significant. However, while in group C-2 there is but little relation between the two variables the correlations in groups E-2 and E-4 suggest a positive relation between chronological age and susceptibility to stress. A more significant result might well have been obtained if there had been a wider range of chronological ages.

IX. Verbal Behaviour

Verbal expressions of emotional agitation, aggression or withdrawal during the experimental sessions were very infrequent. A few items of verbal behaviour which were noted during the entire period of the experiment on all subjects are

Table 28

Rank Correlations Between Chronological Age
and Trials to Learn the First and Second
Soluble Problems.

<u>Group</u>	<u>Chronological Age</u> <u>vs.</u> <u>First Soluble Problem.</u>	<u>Chronological Age</u> <u>vs.</u> <u>Second Soluble Problem</u>
E-1	-.591*	-.503*
C-1	-.224	-.229
E-2	-.261	-.028
C-2	-.055	-.030
E-3	--	-.325
C-3	--	-.208
E-4	--	.125
C-4	--	-.328
E-5	--	-.047
E-6	--	-.113

*shows 1% level of confidence.

given below. No previous scheme of classification has been adopted in its entirety, because none fitted in well with the verbal behaviour of the subjects in the present research. ^{Some of} The ^{orig} classifications items under which the responses have been classified were borrowed from sources referred to. Definitions of such items will be the same as given by the original authors.

Classification of Verbal responses

Implicit Withdrawal:

(28)

"Should I keep doing it again ?"

"I have to carry on with that ?"

Rationalization:

"I keep doing three of them but the last one always goes wrong."

"My hand is shaking; it is always shaking when I am writing."

Ridicule (Implied):

"Oh, it's funny, the white light came, but it's buzzing also."

"That's funny, the buzz again."

Social Responses:

(43)

"Oh, sorry."

"I am sorry."

"I have done it wrong again."

"It's wrong."

"It's wrong again."

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Exclamations:

"Ahh", "Oh, dear." "Phoo." "Ah",
 "Teh", "Shu", "Hum", "Unh", "Shoo".

Miscellaneous:

"Is it the same or a new one ?"
 "What was the pattern here ?"
 "Any good yet ?"
 "I got white."
 "Is any good yet."
 "I got it."
 "I got the white light."
 "I have seen the white light."
 "How long it goes ?"

Responses showing Motivation:

"What is it for ?"
 "I will get it."
 "I think I know the trick now."
 "I will try again."
 "Let me try that."
 "You get a penny every time you get a
 white light."
 "Anybody else got it right ?"

For practice trials - "It won't be counted, Will it ?"

"Will I get the penny if I get a buzz ?"

After the special prize was announced - "Is there ?"

CHAPTER 6

Conclusions and Discussion

Summary of Main Results

The main results of the present research may be summarized briefly as follows. There is no evidence for a significant or systematic relation between the level of intelligence and reactions to stress. There is only partial evidence for the prediction that the effect of stress on subsequent learning increases directly with the level of intelligence. There also is only slight evidence that stress interfered with the transfer of training from one learning task to another. However, there is a significant difference between post-stress learning when exposure to stress is preceded by learning and when it is not. The latter shows relatively greater effect of exposure to the insoluble task on subsequent learning of the subjects. There is no significant effect of different amounts of stress on subsequent learning, neither is there any significant effect of distinguishing the insoluble and the second soluble problems. The secondary measures also fail to show any significant effect of exposure to stress on the subsequent learning of the subjects. The frequent appearance of negative results requires consideration and, if possible, some explanation.

Failure to Reach Stress Threshold

It was essential for the hypotheses being tested that certain groups of subjects be exposed to stress and it was expected that the frustration situation selected would serve this purpose. This expectation was based on results of previous studies where disorganisation of behaviour was produced both in human and infra-human subjects through the application of the present technique. However, the present results indicate that the stress was not sufficiently intense to affect the behaviour of the majority of subjects exposed to it. The only study known to the present writer where exactly the same technique was employed with children of 12 to 14 years of age, showed no significant or systematic effect either of the duration of stress or the length of the period of rest following exposure to stress (46). The results of this study were not available when the present research was designed. Other studies (19) using different situations but similar procedures also have yielded insignificant differences between experimental and control groups.

Effects of Chronological Age Differences on Reactions to Stress

The possibility that particular stress conditions may vary in effectiveness with the chronological age of the subjects exposed to them gains support from a comparison of the present results with those obtained by investigators using

older subjects. Jones (25) made use of this same technique with no knowledge of failure on the insoluble task and obtained significant effects of frustration with college students as subjects. He found a significant difference between 5 and 50 trials on the insoluble problem, but not between 50 and 100 trials. There was no evidence of rigidity in behaviour as a result of frustration. Marquart (42) working within the Maierian theoretical framework, made use of the insoluble problem technique with no knowledge of failure, obtaining significant results and even evidence of "abnormal fixation" in college adults. Russell and Steinberg (62) using conditions very similar to those in the present study, found highly significant differences between control and experimental groups of University students. All these researches employed subjects of about 20 years of age or older who were in every case university students; whereas in the present research the subjects were school children of 112 to 141 months of age. This difference in chronological age and in educational qualifications may be the factors accounting for the differences in results. Moghni (46) using children of 12 to 14 years of age found no general effects of stress; however, he noted that the behaviour of the older subjects in his study was considered more affected by stress than the behaviour of the younger ones. This observation is confirmed

in the present study where the correlations between chronological age and post-stress performance are positive in groups where there is any stress effects. Thus it seems that older subjects may react more readily to stresses of the kind used in the present study than younger subjects.

There is other evidence to suggest that the chronological age of the subject is an important variable in susceptibility to stress. Rosenzweig and Mason (57) point out that "... the older children because prouder were more sensitive to failure and strove for self-vindication, whereas the younger children were not wounded by failure and so ignored it." Barker, Dembo and Lewin (3) in their study noted regression in constructiveness of play due to frustration, but there was a difference in the strength of frustration between younger and older children. They found that for the younger subjects regression was less than for the older. Psychiatrists have noted that older people show more feelings of anxiety and guilt, more intolerance and conservatism, and increasing tendencies towards regression and repetition of childish adjustment techniques (75). Maier and Glaser (41) working with rats found that susceptibility to seizure during auditory stimulation increased rather rapidly with age until it reached a maximum which occurred at about 20 weeks of age.. They also noted that this high point in susceptibility occurs at an age somewhat

after sexual maturity. Finger (16) demonstrated that age was a significant factor in susceptibility to audiogenic seizures. Increasing age revealed a steadily increasing percentage of overtly-reacting animals up to a certain point; beyond this point further age-increments produced a decline in susceptibility. His results clearly indicated that one intrinsic determiner of stress threshold is chronological age. Looking at the present results in this perspective, therefore, it is not surprising that the subjects did not show the effect of the experimental situation to the same extent as did adults.

Subject-Experimenter Relationship

Another important factor which has a great motivational significance is the relationship of the experimenter to the subjects - the perception of the experimenter by the subject. Although nothing definite can be stated about this in the present study, it may be helpful to examine the social situation in which the experiment was conducted. This social setting may assume greater significance with a foreigner as the experimenter. Unlike most of the experiments conducted by university teachers with university students as subjects, in this study the experimenter did not occupy a position of authority or affection. This relationship, therefore, must be borne in mind while interpreting experiments with human subjects. As Liddell (37) points out even in studies at the infra-human level, the intimacy which develops between animal and experimenter during prolonged conditioning must enter into

the appraisal of the results of the experiment.

Positive Transfer From One Task To Another.

The analysis of the transfer effect showed significant positive transfer effects in spite of 50 trials on the insoluble task. This result points to another direction where the possible explanation for the absence of significant effects of stress might be sought. The evidence that most of the subjects in various experimental groups performed better after stress than had been predicted, suggests that some positive transfer effects might have been operative. It is possible that the subjects obtained a better orientation to the situation after working with a problem, no matter whether this attempt was a success or a failure. This orientation presumably was of a general nature in which specific components of the pattern mattered little. Thus transfer of general modes of attack rather than transfer of any specific items of the pattern might have been responsible for greater facilitation in learning the second pattern. The general orientation is facilitated more if there is no adverse effect of the stress-situation as such. In adult subjects, this general transfer may be interfered with by the confusing experience with the insoluble pattern itself, which serves primarily to supply them with false information and thus in certain cases tends to the abandonment of fruitful methods of attack. This might

not happen with children who may be less affected by the specific details of the insoluble problem.

Prior Knowledge of the Pattern

As the effects of the insoluble task were insignificant it might be suspected that the subjects had a prior knowledge of the soluble task. This possibility might appear to be supported by the fact that there are a few cases in certain groups where the subjects learned the soluble pattern in zero trials, i.e., they started with the correct pattern and reached the criterion-score without making a single error. There were five such cases in all the experimental groups. Every possible precaution was taken to safeguard against the possibility of communication between the subjects and there is no reason to suppose that the subjects were not naive. The possibility of communication among the boys having affected the results seems to be minimized by the following facts.

Each child was told that there would be a few special prizes to be given to the boys who were quickest in finding correct patterns. He was also told that he should not tell anything about the situation to other boys, otherwise they would know it beforehand, and, therefore, would stand a better chance of winning a special prize. This appeared to be a real motive for maintaining strict secrecy about the matter.

The boys with lower Intelligence Quotients were called first, the brightest subjects always being the last to

participate in the experiment. This also provided a safeguard against communication among the children about the pattern.

Among the subjects of the experimental groups, 46 children had three patterns to learn; 47 had two patterns, and 48 had only one pattern in the sense that they did not know that the insoluble and the second soluble patterns were different. This would have created confusion even if the boys had desired to communicate. As a further precaution, it was arranged that subjects of the same group never followed each other. The treatment of each group was so different as to make it hardly possible that the knowledge of a child in one group could be of much use to the child in another group.

As Moghni (46) points out, each of the patterns could be verbalised in either of 3 ways; RRL as LLR, RRL and RLR, and LLR as LRL, LLR and RLL. Thus, when the soluble task was presented it could start in any of these ways as a matter of chance. It is unlikely that the pattern was communicated to the subject exactly in the same way as he got it on the apparatus. Table 29 gives the last ten responses on the insoluble task of subjects who learned the subsequent soluble task in five or less trials. The underlined responses indicate the wrong pressings. It might be that the same sequence in which the subject responded in the insoluble task happened to be the correct sequence for the subsequent soluble

Table 29

Last Ten Responses on the Insoluble Task of
Subjects who Learned the Second Soluble Task
in Five or Less Trials.

<u>Group</u>	<u>Insoluble</u>	<u>Soluble LIR</u>
E-1	<u>LRRRLRLR</u>	<u>RRRALL</u>
"	<u>LLRLLRRRL</u>	<u>LIR</u>
"	<u>LLLLLRRLL</u>	<u>LIR</u>
"	<u>LLLRRRLRL</u>	<u>RRL</u>
"	<u>RIRRLRRRL</u>	<u>RRL</u>
"	<u>LRRLRRRL</u>	<u>LRLLR</u>
"	<u>RLLLRLLLR</u>	<u>RLRRL</u>
E-2	<u>RRLRLRLR</u>	<u>RRL</u>
"	<u>RLRLRLRL</u>	<u>LIR</u>
"	<u>RLRLRLRL</u>	<u>LIR</u>
"	<u>RLRLRLRL</u>	<u>RLLR</u>
"	<u>LRRLRRRR</u>	<u>RRRLRRL</u>
E-3	<u>RRLRLRLRL</u>	<u>LRRL</u>
"	<u>RRLRRLLR</u>	<u>RRL</u>
E-4	<u>RLRLRLRL</u>	<u>LIR</u>
"	<u>LRRLLLLL</u>	<u>RIRRLLR</u>
E-5	<u>RRRLRLRL</u>	<u>LRRRRL</u>
E-6	<u>RRRLRLRL</u>	<u>RIRRL</u>

task and therefore, when the change from the insoluble to the soluble phase came, he kept on pressing in the same order and got the pattern. The table does not indicate in any way that such was the case. The only sequence which would have resulted in the most frequent correct responses in the insoluble task was alternately pressing the keys seven times. Obviously the repetition of such a sequence in the following soluble task would not lead to its solution.

Bi-modality

Maier (40) has proposed that "frustration-instigated" behaviour is qualitatively different from "goal-motivated" behaviour. Marquart (42) claimed that the distribution-curve of her subject's rates of learning a post-stress soluble task was bimodal, thus confirming Maier's hypothesis. Recently this hypothesis has been challenged from many quarters (15, 25, 46). Jones (25), comparing his own results from a study of frustration on human learning with those of Marquart, states that "...it would seem to be rather doubtful that an estimate of bimodality could be made on so small a number of subjects and unfortunately there is no statistical test for bimodality."

In the present research, the data and the histograms of the groups might suggest bimodal distributions, but a closer examination tends to support the view that the distribution is one of increasing skewness. The mere fact that the distribution is not normal does not justify the conclusion

that it is bimodal. Accepting for a moment that frustration and concentrated punishment lead to the division of subjects into two qualitatively different populations, the control groups in the present study should tend towards normality and the 100-trial stress groups should show definite signs of bimodality. None of these expectations are justified by the histograms or frequency distributions. All the groups -- both the control and the experimental -- show more or less the same trend of increasing skewness. A number of subjects even in the control groups would be classified as belonging to the "frustration instigated" category as if we were to accept Marquart's criterion of bimodality. Farber (15), defending his own interpretation of the Maierian type of data, states "... it is certainly evident that the frequency distributions for the shock group contain some very high scores, and that they also contain some intermediate intervals in which the frequency was zero. But far from being unusual, these are precisely the characteristics to be expected in skewed distributions based on relatively small numbers. In any event, the conclusion that a distribution of scores is bimodal or multimodal ought to rest on statistical grounds rather than the conviction that it must be so because one's theory demands it."

The present research data support the above criticisms of Maier's hypothesis and confirm the doubts raised by

Jones (25) and Moghni (46) about the bimodality of behaviour under frustration conditions.

Knowledge of Results

Many researches have shown that the knowledge of results facilitates learning and reduces the effects of failure. Anderson (2) states that "...irrespective of success or failure, a definite goal with the possibility of knowing the results of ones' efforts evoked more efforts than an indefinite goal which did not offer knowledge of results." Most of the researches on the level-of-aspiration behaviour have made use of this fact and there seems to be a general agreement that even under conditions of frustration, the knowledge of one's failure is much more facilitating in its after-effects than the absence of it (53). Most researches comparable with the present study have provided no knowledge of result to the subjects and have obtained significant effects of frustration (25, 41).

The present study is distinctive in this regard. Its design included learning situations both with and without the knowledge of failure on the insoluble task. Comparisons between these situations though not significant, seem to suggest that the effect of stress increases up to 50 trials with the knowledge of failure, but that it tends to decrease with further increase in stress; while with no knowledge of failure on the insoluble task, the effect seems to increase in direct proportion to the degree of stress. The results again suggest that the situation with no knowledge of failure

is comparatively more stressful than that with the knowledge of results. The evidence is not significant statistically but points to the same direction as the previous researches. It may be possible that even the no-knowledge situation could not counteract the dominant effect of other variables as discussed above.

The results of the present study may thus be interpreted within the framework of conventional learning theory in terms of young chronological age and a general orientation with the experimental situation. The research as has been outlined in the first chapter was undertaken within a definite theoretical model (61), whereby stress conditions are expected to give rise to interference with behavioural homeostasis and as a result disorganise the adjustive behaviour of the organism stressed. Reactions to such conditions have been shown in medical researches as following a sequence of behaviour, alarm, resistance and exhaustion (64). It may be possible that for most subjects of the present research, the stage of exhaustion was never reached. The experimental situation may have "alarmed" them, but they succeeded in "resisting" it.

Suggestions for Future Research

The present research in attempting to answer certain questions with respect to behaviour under stress, has raised a number of others which should be capable of experimental investigation. A few suggestions for future research in this area follow.

The most important problem for future research in this area is to standardise a stress situation which is realistic to the child. Care must be taken to make instructions as simple and as specific as possible. Various situations can be tried with a representative population of children to determine the relative effect of each situation on them. Moghni (46) reports a preliminary study using modified Pavlovian technique which appears to be a promising approach.

Another important problem for research in this field is to determine the part played by chronological age differences in reactions to stress. A few researches along the same general lines as the present study may lead to the determination of an approximate stage of development where the differences in susceptibility to stress due to chronological age, cease to exist.

Some work along the lines of the present research is needed with feeble-minded subjects and with subjects of superior intelligence. Such research might have interesting implications for both teachers and psychologists.

Another important area for future research is the investigation of the extent, if any, to which past frustrations affect reactions to present stresses and what role cognition plays in such a process.

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