STUDIES IN LEARNING IMPAIRMENT. II: PSYCHONEUROTIC PATIENTS.

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In the first part of an experimental study of learning impairment (Hall and Crookes, 1951) the present writers described some of the distinctive features of the performance of schizophrenic and organic patients on two learning tasks. Brief reference, by way of introduction, was also made to studies of learning efficiency in psychoneurotic patients which were carried out by Zangwill (1943, 1946) and Trist (1941). These writers, and also Davis (unpublished), noted particularly some of the reactions and types of failure that neurotic patients sometimes show, with special reference to the Rey performance test. Certain reactions to the test were felt to be characteristic, for example, of patients with anxiety states or hysterical reactions, although none of the writers had carried these observations further or confirmed them experimentally.

In the present paper, therefore, we have made an attempt to follow up and verify these observations, in order to try and establish, at any rate in a preliminary way, (i) whether or not patients classed as psychoneurotic tend to be less efficient in learning than comparable normals, (ii) whether, as the previous writers contend, there are any characteristics of learning performance which are at all distinctive within the psychoneurotic group; for example, do anxiety cases show any difference from reactive depressives, obsessionals or hysterics, or are the variations that these writers observed merely general to the neurotic group as a whole?

Learning Tasks.

To investigate this problem the same two tasks (one verbal, one performance) were used as for Part I of the experiment. A brief summary of these tasks is as follows:

(i) The verbal task consists of 10 pairs of words, which have to be learned so that, when only the first word of a pair is given following the reading through of the complete list by the experimenter, the patient can produce its correct associate. This procedure is repeated up to a maximum of 10 times, or until all the 10 pairs have been correctly recalled at any trial before the 10th.

(ii) The performance task consists of learning 5 different combinations of three two-way switches shown on a panel. Each of the correct combinations of the switches will turn on an electric bulb visible to the patient. Each move of the switches that the patient makes in carrying out the task is recorded on a chronograph, the patient being allowed up to a maximum of 10 trials to find out and learn to set these 5 combinations in the least possible number of moves.

Both tasks allow for some objective assessment of learning progress, together with opportunity for recording the qualitative features of a patient's performance.

Clinical Material and Control Group.

The normal control subjects were the same for this experiment as for Part I of this investigation. The control group for the word-pair learning consisted of 32 subjects of both sexes, and that for the switch learning consisted of 26 subjects of the same group. A Wechsler vocabulary score was obtained for each subject. Age and vocabulary score distribution is similar to that of the psychoneurotic group, age range being from 17 to 46, average 29·0, although the average vocabulary score of 30·5 is slightly higher.

The psychoneurotic group consists of 71 patients of both sexes. The age range is the same as that for the normals (17 to 46). Clinically, some of the patients show a mixed symptomatology, but the subgrouping according to primary symptoms is shown in Table I, together with sex distribution, average age and average Wechsler vocabulary score for each of the 4 subgroups.

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TABLE I.

Primary symptoms.	Sex distribution. Male.	Female.	Total.	Average age.	Average vocabulary score.
Anxiety	17	22	39	29·9	26·7
Depression	9	10	19	31·3	26·9
Hysteria	2	5	7	24·0	21·3
Obsessional	3	3	6	31·2	29·0
Total	31	40	71	29·8	26·4

Within the psychoneurotic group the hysterics are both younger and score lower on vocabulary than the normals and the other three neurotic groups. The two main neurotic groups, the anxiety and reactive depressive cases, show very little difference in either respect.

RESULTS.

1. *Word-pair Learning.*

Performance of each patient on the word-pair task was analysed and scored in three different ways:

(i) Mean number of correct recalls per trial.

(ii) Lapses in score: this is the sum of the amounts by which the number of recalls on each trial falls below the level already reached on the preceding trial. For example, if a patient were to recall 6 word-pairs on trial 1, 8 on trial 2, 6 again on trial 3, thereafter maintaining or improving his score until the maximum was reached, his lapse score would be 2.

(iii) Forgetting index: this is found by obtaining the mean number of word-pairs forgotten per trial. For example, if a patient recalls correctly the word-pairs "old—easy," "general—small," "thought—comfort," on trial 1, then forgets two of these on trial 2, 3 of those that he recalled correctly on trial 2 at the third trial, but recalls all 10 correctly on trial 4, his forgetting index is 5 divided by 4 = 1·25.

By treating the results in this way, we find not only a considerable overall difference between normals and neurotics, but also various characteristics of performance or failure emerge from examination of results within the neurotic group itself.

(i) *Mean Correct Recalls.*

Comparison of the normal group with the whole neurotic group on this score shows that the former recall a much greater number of pairs. The means for the two groups are highly significantly different (the value of $t = 3{\cdot}984$, which gives a probability of chance occurrence of less than ·001).

The scores for the subgroups of neurotics are shown below, the abbreviations N = Normal, A = Anxiety, D = Depressive, H = Hysteric and O = Obsessional, being used in all subsequent tabulation of results.

	N.	A.	D.	H.	O.
Mean number of correct recalls per trial	8·48	6·98	7·08	6·37	7·12

Analysis of variance was applied to these data. The estimates of variance derived from the differences (i) between the five groups, and (ii) within the groups, give a variance ratio of 4·13, which gives a highly significant value of $P = < {\cdot}01$. Although the numbers of H and O patients are too small to allow of reliable conclusions, it is worth noting that the H patients are the worst and the O patients the best of the neurotic group.

This difference between the normal and neurotic groups is emphasized by consideration of the actual percentage of cases in each group who fail to reach a perfect score after the maximum 10 repetitions of the word-pairs. Only 12·5 per cent. N fail to reach maximum, as compared with 33·3 per cent. A and 36·9 per cent. D.

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(ii) *Lapses in Score.*

The mean amount lapsed, together with the percentage of cases in each group who have no lapses at all, is shown below:

	N.	A.	D.	H.	O.
Mean amount lapsed . .	0·56	1·31	1·63	2·14	1·50
Percentage of cases with no lapses	72	44	42	14	67

With regard to the amount lapsed, the A group is closest to the normal, although all neurotic groups tend to be considerably poorer. The proportion of cases having no lapses to those with lapses is significantly different as between N and A, N and D, N and H, but not between N and O (values of chi^2 are: N and A — 5·72, N and D — 4·38, and N and H — 5·80, with corresponding probabilities of $< \cdot 02$, $< \cdot 05$ and $< \cdot 02$ respectively).

(iii) *Forgetting Index.*

The index for each of the five groups is as follows:

N.	A.	D.	H.	O.
0·45	0·56	0·59	0·51	0·53

All the neurotic groups have a higher average score than the normals, but analysis of variance yields a high value of P, so that little significance is to be attached to the differences. The differences between N and A and between N and D, considered separately by the *t* method, are not significant.

The general implication for the findings on the word-pair task seems to be that, although the neurotics are worse in learning the material than the normals, this is due not so much to any retention defect as to their inability to sustain the necessary effort throughout the task. Hence they show a very much greater tendency than the normals, not to forget what they have already learned, but to lapse below their previous level of attainment—as though their learning effort is typically less concentrated, more dispersed and superficial.

(iv) *Difference on Word-pair Learning between Males and Females.*

There is some evidence of differences in performance on this task between the male and female subjects. This is shown by the scores for N, A and D males and females given in Table II below.

TABLE II.

	Mean correct recalls.		Lapse score.		Forgetting index.	
	M.	F.	M.	F.	M.	F.
N . . .	7·86	9·02	1·00	0·18	0·55	0·34
A . . .	6·32	7·48	2·00	0·77	0·62	0·52
D . . .	7·53	6·67	1·00	2·20	0·43	0·74

From inspection of this Table it will be noted that the N and A females tend to do better than the males, while, on the other hand, the female D patients are *worse* than the males. The O patients show a similar trend on mean correct recalls, M being 7·53 to F 6·70. While no general significance can be attached to these observations without further confirmation, they may constitute at least one factor accounting for the inter-group variation.

2. Switch Learning.

Three different scores are also obtained for each subject on the switch-learning task. These are:

(i) Learning score: Mean number of switch combinations correctly recalled, and multiplied by 2 in order to be comparable with the equivalent score on word-pairs, both tasks having a maximum possible score of 10.

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(ii) Trial and error scores: Two ways of scoring trial and error on this task have been used:

(*a*) The number of switch moves made by each individual on the 1st trial of the series, and—

(*b*) The mean number of moves required to reach each correct combination when this has not been correctly recalled.

(iii) Forgetting index: The mean number of switch combinations forgotten per trial.

In addition, (iv) the average time taken per move has been calculated.

(i) *Learning Score.*

Mean learning scores for the 5 groups are as follows:

N.	A.	D.	H.	O.
6·77	6·26	5·37	5·40	4·77

The difference between the means of the normal and the whole neurotic group is significant ($t = 2{\cdot}197$, $P = < {\cdot}05$). However, analysis of the variance between N, A and D, and between all 5 groups, shows that the between-group differences are not quite significant. The variance ratio for N, A and D is 2·44, with P just over ·05, while the variance ratio for all 5 groups is 2·19, which is still not quite significant. The difference between N and D separately is significant ($t = 2{\cdot}460$, $P = < {\cdot}02$).

(ii) *Trial and Error Scores.*

(*a*) The average number of moves made by each group on the 1st trial of the switch task, when the individual has to discover for himself by trial and error how the switch combinations occur, is as follows:

N.	A.	D.	H.	O.
25·46	34·0	39·2	28·9	40·0

It will be seen that all the neurotic groups have a higher average than the normals. While analysis of the variance between the 5 groups shows these differences to be not quite significant (V.R. = 1·70, $P = > {\cdot}05$), and separate comparison of N and A is just below the ·05 level, both D and O patients have a significantly greater number of moves than the normal (values of t are 2·386 and 2·557, $P = {\cdot}02$ and less than ·02, for D and O respectively).

There is, therefore, a general trend for the neurotic patients to have an approach to the initial stage of the task that is less systematic and shows perhaps less appreciation of the limited possibilities of correct solution than the normal. This tendency is perhaps surprisingly marked in the obsessional patients, who show the highest number of moves of all the groups. The hysterics are nearest to the normals.

(*b*) The second kind of trial and error score provides some indication of the individual's reactions in the sequence and method of learning throughout the task. It was thought that this measure would serve a similar purpose to the lapse score in the word-pairs, indicating the capacity to sustain the learning effort. The mean scores for the 5 groups are:

N.	A.	D.	H.	O.
7·12	7·80	7·93	8·23	8·38

There is no significant difference between any single neurotic group and the normals. The obsessionals are again the worst.

(iii) *Forgetting Index.*

The mean value of the forgetting index for each of the 5 groups is as follows:

N.	A.	D.	H.	O.
0·44	0·51	0·58	0·60	0·52

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Although there is a general tendency for the neurotics to show more forgetting than the normals, analysis of the variance shows that the difference is not significant. Separate comparison of D and H with N is almost significant at the ·05 level.

(iv) *Average Time per Move.*

Average times, in seconds, taken on each move are :

N.	A.	D.	H.	O.
2·41	2·10	2·99	2·17	2·09

Analysis of the variance between N, A and D is significant (variance ratio is 4·57, $P = < ·05$). The difference between A and D separately is significant, the D group being markedly slower than all the other 4 groups. The fact that the patients of the A, H and O groups all tend to make the switch moves quicker than the normals seems to indicate that their approach to the task, and their attitude towards solving it, is less deliberate.

A general summary of the findings on this switch-learning task seems to show that, whereas all the first three aspects of the learning performance show the normals to come out rather better than the neurotics, the differences between them are not so great as might have been expected. In all aspects of the performance the anxiety patients are nearer to the normals than the depressives. In fact, there is no statistically significant difference on any of the three measures, or in tempo of moves, between the anxiety group and normals. The depressives, on the other hand, are significantly worse than the normals on learning score and trial and error, and they tend to forget more than the normals. They are also, as was to be expected, considerably slower.

As far as the hysterics and obsessionals are concerned, the number of cases is too few to allow of any definite conclusion. Certain features of their performance are, however, quite suggestive, and might repay further study. For example, except on the forgetting scores, the hysterics learn rather surprisingly better than the obsessionals, having a much lower trial and error score, and a higher learning score. Although the average age of the hysterics is lower, their average intelligence is also lower ; so that there is a possibility that, on this task at any rate, some such feature as over-preoccupation may interfere considerably in the obsessional's learning progress.

(v) *Difference Between Sexes.*

As with the word-pair task, we find that there are certain differences between the performance of males and females within the clinical groups. Table III below shows the mean scores in each group of males and females taken separately. (The hysterics are not included, as there were only 2 male cases.)

TABLE III.

	Learning scores.		Trial and error scores. (*a*)		Trial and error scores. (*b*)		Forgetting index.	
	M.	F.	M.	F.	M.	F.	M.	F.
N	6·39	7·27	23·5	28·2	6·58	7·86	0·52	0·34
A	6·21	6·30	33·4	34·5	7·52	8·02	0·53	0·51
D	6·40	4·44	32·4	45·2	7·62	8·20	0·52	0·64
O	4·73	4·80	36·7	43·3	8·47	8·30	0·57	0·47

It will be seen from these figures that in the normal group the females make a better learning score than the males, and have a lower forgetting index, but make a higher, that is, worse, trial and error score. This confirms the finding in the word-pair task that the females retain better than the males, but it suggests further that they are less good at finding the position when it is not retained, that is, at making a systematic elimination of the different possibilities.

In the anxiety group males and females are little different, but in the depressive group we find, as in the word-pairs, that the males are greatly superior in all the three scores.

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If the three main groups only are considered, it will be seen that there is hardly any difference between the males in learning scores and forgetting index, so that almost all the variation between the clinical groups is due to the differences among the females, mainly the difference between normal and depressive females.

This inferiority of female depressives to both male depressives and the other females may, in part, be due to age (average of female depressives is 33·4, that of male depressives 29·0), but the possibility remains that in the females the depressive symptoms are more generalized, and thus cause a greater impairment of concentration and motivation required for carrying out tasks of this kind.

3. *Comparison of Performance on the Two Tasks.*

By comparing the learning scores on the two tasks for each subject, we can get some idea of the relative performance of each group on the different tasks. Every group makes a higher average score on the word-pairs than the switches. The mean differences between the scores (word-pair score minus switch score) are shown below :

N.	A.	D.	H.	O.
1·22	0·72	1·71	0·97	2·35

A higher value means a relatively better performance on word-pairs. Thus, compared with the normals, A and H are relatively better on switch-learning, D and O on the word-pairs.

The fact that all groups make a higher score on word-pairs does not necessarily mean that the word-pairs are easier, as the scores may not be comparable, but there is other evidence that the word-pairs are found less difficult, in the fact that a larger proportion of all groups fail to reach a correct solution on the switches, as indicated below :

		N.	A.	D.	H.	O.
Per cent. failures	Word-pairs	12·5	33·3	36·9	42·9	50·0
	Switches	30·8	48·7	63·1	57·1	83·3

Thus it is strange that the anxiety group are relatively less impaired on the harder task, as emotion is thought to have a greater disturbing effect on more difficult processes.

There is a general tendency for females to be relatively better on the verbal task. Mean differences between the two scores (word-pair score minus switch score) for males and females separately are shown below :

Normals.		All neurotics.		All subjects.	
M.	F.	M.	F.	M.	F.
0·88	1·60	0·83	1·39	0·84	1·43

General Summary and Comment on Both Tasks.

In almost all respects the anxiety cases come closest to the normals on these tasks. As a group they tend to do worse on both tasks than the normals, but this is due mainly to the poor performance of a few individuals. Even on what has been considered a neurotic characteristic, as measured by the *lapses* in performance on either task, we find that a few cases lapse very much more than the normal, but that the majority are little different in this respect. We can therefore conclude, in-so-far as our particular groups are concerned, that, whereas the emotional disturbance is great enough in some of these patients to make them differ markedly from the normal average and to make them show " neurotic " tendencies such as spoiling their performance, failing to sustain the necessary mental effort and initial progress, the majority are not significantly worse than the normal. This finding, confirmed statistically, indicates the need for caution in drawing any conclusion as to the learning inefficiency of such patients when compared with the normal. Some of the normals were themselves undoubtedly performing, particularly on the switch-learning task, below their optimum level of efficiency owing to a temporary situational anxiety.

The depressive patients, on the other hand, are significantly worse than the

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normals in almost all respects, and they therefore also tend to be worse than the anxiety cases. They are slower on the switches, they show a marked and significant tendency to lapse in their performance on both tasks, and they tend to forget what they have learned. It is particularly striking in this group how the female patients are more impaired than the male. The emotional disturbance of the former seems to have involved their concentration, their motivation toward the task and the experimental situation in general, and consequently their attitude towards their own performance, more profoundly. This seems to confirm the clinical impression of these patients.

Our findings for the hysterics and obsessionals can be taken as merely suggestive, and as perhaps indicating possibilities for further experimental research. The obsessionals, although they have the highest average intelligence of all the neurotic subgroups, are surprisingly poor on the switch-learning task, there being a very marked discrepancy between their scores on this and on the word-pairs. Possibly the orderly and systematic approach required for good solution of this task is impeded by obsessional adherence to particular move sequences already worked out by the patient, so that any breakdown in sequence caused by failure on a combination which the patient thought he knew may make it difficult for the patient to revise his scheme of approach. This would appear to be a phenomenon closely similar to the " rigidity " of concept formation which Rapaport has observed in such patients carrying out the Vigotsky sorting test. This adjustment difficulty is also shown by the fact that the obsessionals have the highest trial and error score of all the groups.

The hysterics, in contrast to the obsessionals, have the poorest learning score on the word-pairs, and show the greatest number of lapses on this task. They have also the lowest average vocabulary score, so that this task is probably proportionately more difficult for them. They are nearest of all the neurotic groups to the normals on trial and error score—at the opposite extreme to the obsessionals —so that there seems to be here a difference of some significance in approach to this task, the hysterics appearing to adjust quite easily to the sequence of switch combinations, and to eliminate errors with little difficulty.

In answer to the two questions posed at the beginning of this paper, (i) there is evidence of reduced efficiency in the word-pair learning among psychoneurotic patients, but for the switch task the evidence is not very clear, and (ii) there are signs, which have been discussed, of qualitative and quantitative differences in performance among the sub-groups of psychoneurotic patients ; but the aetiology of these differences is confused by the relatively great sex differences which have been observed simultaneously, especially in the switch-learning.

In general, progressive tasks of the kind used in the present study seem to bring out quite clearly certain features of so-called learning efficiency which cannot be objectively assessed with standard tests. By scoring and recording various different aspects of the whole learning performance, it is possible to distinguish something of the characteristics, qualities and extent of the emotional interference with the cognitive process. Not only differences in actual learning, but in method of approach, in ability to sustain mental effort and to recover after failure, are of varying importance in the performance of the neurotic patients. Some features of the results require further experimental study and corroboration, and the observed differences between male and female patients should lead investigators in this field to be cautious in the conclusions they may draw from results obtained with mixed groups.

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