AN EXPERIMENTAL STUDY OF LEARNING AND "MEMORY FUNCTION" IN ELDERLY PSYCHIATRIC PATIENTS

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A PAPER by Shapiro, Post, Lofving, and Inglis (12) has reported on the relationship of certain aspects of mental functioning to the psychiatric illnesses of old age. This study confirmed that performance on some tasks which appeared to involve "memory function" is relatively more impaired in elderly patients with organic brain pathology than in elderly patients with functional psychiatric disorders. It was also shown, however, that the difference between functional and organic groups on these memory tests was not as great as might be expected on the basis of the commonly held psychiatric hypothesis that memory disorder is one of the leading features of early cerebral involvement in old age. The relatively poorer performance on these memory tests of the organic patients could not be accounted for in terms of, for example, lower intelligence, since the memory tests produced significant differences between the organic and functional groups whereas the intelligence tests did not. A process of correlational analysis (Inglis, Shapiro, and Post (8)) showed that these tests did seem to have some psychological function in common which could usefully be labelled "memory".

It should be emphasized that the first study quoted above was mainly concerned with diagnostic problems while the present paper is concerned with the investigation of memory disorder as such. It is a matter of common observation and concern that many old people suffer from "failing memory" and it is considered that the nature of such dysfunction deserves investigation in its own right, divorced from diagnostic considerations. The present study represents an attempt to make such an examination.

METHOD

Subjects

The individuals tested consisted of an experimental group of eight elderly patients clinically estimated to be suffering from undoubted memory disorder. This estimation was done by the consultant psychiatrist in charge of the cases (Dr. Felix Post) on the basis of a full psychiatric investigation of each patient. The main elements in this investigation relevant to the assessment of memory disorder were (*i*) if the patient himself complained of failing memory, (*ii*) if any evidence emerged on examination that the patient's memory was impaired; for example, if he could not remember the name of the hospital or his doctor's name, and (*iii*) if relatives complained about the patient's memory; for example, if the patient forgot errands or frequently lost his whereabouts.

A control group of another eight patients without memory disorder was also tested. Each of these was closely matched with a member of the experimental group in terms of chronological age and also in terms of Verbal Scale

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Weighted Score as obtained from the Wechsler Bellevue intelligence test (Wechsler (13)). There were three men and five women in each group, all being patients of the geriatric unit of the Bethlem Royal Hospital. All the patients were co-operative during testing and none suffered from any sensory defect so severe as to interfere with test performance.

Variables

The functions subsumed under the concept of memory are regarded by the present writer as a part of the study of human learning in general. As McGeogh and Irion point out (9, p. 6), "It has long been customary to divide the field into two main parts, 'learning' or fixation, and 'retention'. At the level of logical analysis this division is clear because an act must be fixated before it can be retained. In the learning of complex acts by continued practice, however, our measurements do not often separate fixation from retention, and the two are intermingled in each practice trial after the first. For the sake of convenience, the distinction between learning and retention has been given a different meaning from the logically analytic one, *learning* being used to designate the acquisition of changes in behaviour during a specified time or to a certain level, and *retention* being used to mean any measured persistence of these changes after practice ceases."

It should be noted, however, that neither the common nor the clinical use of the term memory usually differentiates explicitly between such phases. Usually most attention has implicitly been paid to the retention stage. It was therefore thought necessary, in the present study, to use tests which could in principle give some measure of these different phases in as simple and as objective a way as possible. It also seemed desirable that the effects of different interests and of previous experience should be reduced to a minimum, and that the testing procedure should be as brief and as constant as possible. The method that seemed to meet these criteria most satisfactorily was the method of paired associates.

Paired Associate Learning Tests

In using this technique it was necessary to take into account possible differences which might arise in different learning modalities (e.g., auditory/visual) or from different modes of reproduction (e.g., recognition/recall). The following subtests were therefore devised.

Auditory Recall—In this subtest the patient had to learn to associate three pairs of words auditorily presented (cabbage–pen; knife–chimney; sponge–trumpet). The examiner first read the list of words two at a time, at the same time asking the patient to remember which words went together. After this presentation the examiner then read the stimulus words to the patient, one by one in random order. The patient then had to recall which response word went with each stimulus word. If the patient could not give the response within ten seconds, or gave the wrong one, the correct word was read to him by the examiner. If the patient gave the right answer this was acknowledged and the next stimulus was given.

The criteria according to which this subtest and the other paired associate subtests were scored, are discussed under "*Results*" below.

Visual Recall— In this subtest the three pairs of stimuli to be learned were simple drawings on cards (candle–cup; book–brush; spectacles–jug). The method of administration was the same as in the Auditory Recall subtest except that for the first presentation the cards were shown in pairs from behind a screen.

The patient could not always be prevented from calling out the name of the object shown in this way, but this was avoided as far as possible. After the first presentation the patient was required to give the name of the response object on being presented with the stimulus card alone. Prompting was done by showing the correct response card.

Auditory Recognition—In this subtest the subject had to learn to associate another three pairs of words (flower–spark; table–river; bottle–combe) auditorily presented, exactly as in the Auditory Recall test. Instead, however, of having to recall the correct response word as each stimulus word was read by the tester, the patient had to choose the correct word from the list of three responses as these were read aloud in random order by the examiner. Failures and wrong responses were corrected verbally.

Visual Recognition—This subtest resembled the Auditory Recognition subtest except that the stimuli were again presented drawn on cards (pipe–umbrella; tap–axe; pencil–key). After the initial demonstration the subject had to recognize the correct response card out of the set of three which the examiner showed one at a time in random order after each stimulus presentation. Wrong responses and failures were corrected by the subject being shown the correct card.

Digit Span Tests—This type of test is often used clinically as a "memory test", although some authors have denied that it tests any such function (Hopkins and Roth (7)). In order to test the merits of these different views the following items were included.

(*i*) The first measure was provided by the Wechsler Digit Span forward items which, of course, require auditory presentation and verbal recall.

(*ii*) The second measure, like the third and fourth below, was an adaptation of the Knox Cube Digit Span Test. In this item the digit series was tapped out by the examiner on four cubes. The subject was required to tap the series back. This method involved visual presentation and manipulative recall.

(*iii*) In this third subtest the subject was told to think of the cubes as being numbered from one to four and was coached in this notion until he had grasped it adequately. The digit series was then tapped out by the examiner and had to be recalled verbally by the subject. This method therefore involved visual presentation and verbal recall.

(*iv*) Fourthly, the examiner read out the series and the subject had to tap out his answer on the cubes. This test involved auditory presentation and manipulative recall.

RESULTS

The means and standard deviations of each variable for the experimental and control groups are shown in Table I. The significance of the differences between the group means for each variable was estimated by Sandler's A test (11). It has already been pointed out that the two groups were composed by the method of matched pairs. An advantage of this method, according to Dixon and Massey (5) is that we need not assume equality of variance on the variables being examined, so that for the purpose of this analysis any differences in variance have been disregarded.

1. AGE:

Since the groups were matched in age they were not, of course, significantly different on this variable. The initial matching was done in such a way that the control subject chosen would always be, if anything, slightly older than the paired experimental subject. This explains the slightly, but not significantly, higher mean age of the control group.

TABLE I

		Variable	Experimental m	Experimental σ	Control m	Control σ	A	P
Wechsler		Age	65·75	8·19	67·25	7·17	0·306	NS
		VSWS ..	33·88	8·90	30·50	8·42	0·284	NS
		PSWS	13·50	13·77	26·50	9·75	0·305	NS
		VS-PSWS ..	20·38	13·53	4·00	9·97	0·223	·05–·02
		FSWS	47·38	18·84	57·00	15·25	0·538	NS
Paired Associate Learning Tests	a	Aud. Recall ..	59·25	23·60	14·13	4·55	0·150	<·001
		Vis. Recall ..	50·25	29·20	6·63	3·70	0·169	·01–·001
		Aud. Recog. ..	51·88	29·61	7·50	3·42	0·174	·01–·001
		Vis. Recog. ..	35·38	22·59	6·00	2·51	0·185	·01–·001
	b	Aud. Recall ..	1·50	1·42	3·00	0·00	0·222	·02
		Vis. Recall ..	1·88	1·36	3·00	0·00	0·284	NS
		Aud. Recog. ..	1·75	1·49	3·00	0·00	0·280	·05–·02
		Vis. Recog. ..	2·13	1·25	3·00	0·00	0·347	NS
Digit Span		Aud.-Verb. ..	5·50	0·76	5·75	0·89	1·000	NS
		Vis.-Man. ..	4·38	0·92	4·25	0·46	9·000	NS
		Vis.-Verb. ..	3·63	1·60	4·13	1·36	1·250	NS
		Aud.-Man. ..	4·38	1·06	5·25	0·46	0·265	·05–·02

2. INTELLIGENCE:

Verbal Scale Weighted Score—Since the subjects were paired on this variable also, no significant difference emerges. The matching on this variable was done so that, if anything, the control subject would obtain a slightly lower score than the paired experimental subject and this tendency is reflected in the means.

Performance Scale Weighted Score—The difference between the means is not significant on this variable but an interesting trend is reflected in the direction of the difference. Although the pairs were chosen as described on the Verbal Scale score the difference between the groups on the Performance Scale goes, if anything, in the *other* direction; that is to say the experimental group, on the average seems to get a lower score on the Performance Scale than the control group.

Verbal minus Performance Scale Weighted Score—In order to find out if this last observation represented a reliable tendency the mean difference Verbal minus Performance was tested and found to be significant. When initial difference in intellectual level is held constant, then elderly patients with memory disorder tend to get much lower Performance than Verbal Scale Weighted Scores as compared with patients without memory disorder. The psychological significance of this finding will be discussed later.

Full Scale Weighted Score—The difference as between the means on this measure was not significant.

3. PAIRED ASSOCIATE LEARNING TESTS:

Although it is possible, in principle, to obtain scores for both acquisition and retention on this kind of test; in practice, on this occasion, it did not prove feasible to obtain measures of both these aspects of learning. Scores of acquisition alone were obtained because no test was simple enough to enable all the

subjects to learn the required criterion. Unless such a common criterion is reached then strict comparisons between individuals as to the amount they retain is impossible.

The following results, concerned with acquisition, were obtained:

(a) *The number of trials to acquire the associates to a criterion.* In each subtest the subject had to learn to associate the three pairs of stimuli to a criterion of three consecutive correct responses for each pair. If the subject failed to learn them all correctly to this criterion the test was stopped after thirty repetitions of each pair. Thus the maximum score on each subtest was 93 (thirty repetitions of each pair plus the first presentation in each case), and the minimum score was three (i.e., if the subject learned perfectly on the first presentation of each pair).

Each of the subtests showed very significant differences between the groups, that is to say, the experimental group required very many more trials to learn. There is thus shown a definite connection between the number of trials taken to learn pairs of stimuli to a criterion and the clinical impression of memory disorder. It can therefore be concluded that a defect in the first stage or phase of learning (i.e., a defect of acquisition) is an important element in memory disorder in elderly psychiatric patients.

(b) *The number of items learned to the criterion.* This second score consists simply of the number of items actually learned to the criterion within each subtest. Since each subtest consists of three items the maximum score, which is, in this case, the "best" score, is three, and the minimum, or "worst" score is 0.

Although there are no uniformly significant differences between the groups, nevertheless interesting results do emerge. For example, in the case of the control group no one failed to learn each pair to the required criterion, therefore in this group there is no variance on this measure. Individual differences in the number learned were, however, shown in the experimental group.

For neither of these measures, (a) or (b), does sensory modality of presentation, or method of reproduction, seem to make much difference.

4. DIGIT SPAN TESTS:

The score on each item in this group was the longest digit series repeated without error.

On the basis of the results obtained it can be stated that this kind of test is not related to any function relevant to differences in memory in elderly patients. Only one of the four subtests shows a significant difference between the groups and this at a low level of confidence.

This finding runs counter to a common clinical practice which regards such items as "tests of immediate memory".

This conclusion is, of course, in accord with the opinion expressed by Hopkins and Roth (7), and also with the clinical findings of Zangwill (14) who found that patients with marked memory defect can show quite large "memory span" on digit tests, but that such patients may nevertheless fail to *acquire* an only slightly longer digit series than the one which they successfully reproduced at first trial attempt.

The results of the present study, concerning these digit span tests, are of additional interest in so far as they help to rule out the notion that the patients in the experimental group might have suffered from a greater incidence of peripheral difficulty which might have handicapped them in the learning tasks.

Discussion

Two main findings emerge from this study.

Firstly, that patients suffering from "memory disorder" have a marked disability in the acquisition phase of learning paired associates. This finding may, in part, explain "Ribot's law of regression" as applied to elderly people with memory disorder. Thus, recent events are simply not learned (i.e., acquired) by such individuals while remote events, on the other hand, are more available simply because they were, at one time, more efficiently acquired. The approach used in this study permits the operational analysis of clinical impressions and provides a method for examining memory deficit in an objective, quantifiable way, relatively independent of the subject's past experience.

The second main finding in this study is that elderly patients with memory disorder show a large discrepancy between their results on the Performance and the Verbal Scale of the Wechsler.

The relationship between these two findings was examined further by running rank correlations (rho) (McNemar (10)) between Verbal minus Performance scores and the trials to acquisition scores on each of the four paired associate learning subtests. These correlations are shown in Table II.

Table II

	Experimental				Control			
	Aud. Recall	Vis. Recall	Aud. Recog.	Vis. Recog.	Aud. Recall	Vis. Recall	Aud. Recog.	Vis. Recog.
VS-PSWS	+0·83^{xx}	+0·66	+0·71^{xx}	+0·85^{xx}	+0·55	+0·19	+0·50	+0·05

^{xx} ρ (rho) significant at 1 per cent. level of confidence.

The correlations within the experimental group show a large positive relationship between the Wechsler difference scores and the learning trial scores while no such relationship is shown in the case of the control group. There is very little variance on the learning tasks in the control group and hence no covariance of these tasks with the discrepancy scores in that group. A possible explanation of the differences in correlation may be that the learning tests were too easy for the individuals without memory defect and variance might be obtained in this group on these tasks, and hence perhaps covariance with the discrepancy scores, by making the learning tests longer.

In attempting to relate the findings of the present study to other work in the field it is of interest to consider them in relation to Cattell's discussion of what he has called "fluid ability" and "crystallized ability". In drawing a distinction between these two kinds of adult mental capacity this author has noted (3, p. 178) that, "Fluid ability has the character of a purely general ability to discriminate and perceive relations between any fundaments new or old. It increases until adolescence and then slowly declines. . . Crystallized ability consists of discriminatory habits long established in a particular field, originally through the operation of fluid ability, but no longer requiring insightful perception for their successful operation. Intelligence tests test at all ages the combined resultants of fluid and crystallized ability, but in childhood the first is predominant whereas in adult life, owing to the recession of fluid ability, the peaks of performance are determined by the crystallized abilities."

M. Davies Eysenck has also used this distinction between the two types of ability in her studies of mental organization in senility. In one study (6) she factor analysed the test performance of a group of senile dementia patients and found that the kind of deterioration from which they were suffering affected most strongly tests involving abstract reasoning ability (i.e., fluid ability) and affected least tests involving a mere reactivation of past experience and knowledge (i.e., crystallized ability).

Thus, for any individual, a problem-solving situation, such as intelligence test, can be thought of as involving both components which require the "running off" of old habits, and others which require completely new kinds of solution-responses.

It may be suggested that, for most elderly people, the two scales of the Wechsler may differentially involve these two types of ability. In responding on the Verbal Scale, for example in defining words, the subject is exhibiting his achievement on "old learning". In the case of the Performance Scale, on the other hand, the material is much less familiar and many more novel response patterns have to be initiated. This view is consonant with the findings of Botwinick and Birren (1) which show that, although the amount of decline in a Wechsler subtest with age is not necessarily a criterion of its ability to differentiate between control and senile deteriorated populations, nevertheless the absolute level achieved by either group is relatively higher in the case of the Verbal Scale average than in the case of the Performance Scale average (Controls: Verbal Scale mean, 7·26; Performance Scale mean, 6·19. Seniles: Verbal Scale mean, 5·61; Performance Scale mean, 3·54).

Bromley (2) has reported a study in which he used the Shaw test with elderly subjects. This study produced evidence that tests of this type (i.e., involving "sorting") may measure "fluid ability". A connection between this type of test and the Wechsler had previously been shown by Cleveland and Dysinger (4). These authors tried to relate certain qualitative aspects of senile deterioration, as estimated by performance on the Goldstein Object Sorting Test, to results on the Wechsler. They showed that, in fact, a low or zero score on the Performance Scale of the Wechsler together with a much higher score on the Verbal Scale was accompanied by an inability to handle the type of abstractions necessary for success on the Object Sorting Test.

It may be, therefore, that the so-called "abstraction ability" involved in tests requiring novel solutions are related to each other. The findings of the present study suggest that these may, in turn, be dependent upon, or at least related to, "new learning ability". This relationship is being explored in a further investigation.

CONCLUSIONS

1. It has been shown that certain elderly psychiatric patients clinically assessed as suffering from some disorder of memory have great difficulty in the acquisition stage of learning paired associates.

2. It has also been shown that such patients produce a larger mean discrepancy between the Verbal and Performance Scales of the Wechsler than do a group of controls. For the experimental group the size of this discrepancy is related to the amount of the learning difficulty.

3. It therefore appears that the connection between learning ability and impairment, "abstract ability" and "fluid ability" may prove a fruitful area of experimentation in the attempt to investigate the behavioural correlates of memory disorder. Further experiments in this area are now in progress.

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Dr. R. W. Payne, in an unpublished series of case studies, has made observations similar to these findings on patients suffering from Korsakoff's syndrome.

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