

A VISUAL RETENTION TEST FOR CLINICAL USE

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The visual retention test to be described here was developed as a practical means of fulfilling what I have long felt to be a need in the usual clinical examination of patients, namely, a short test to supplement the auditory-vocal digit span test in the investigation of immediate memory.

The auditory-vocal digit span test, devised in 1887 by Jacobs,¹ has become a stable feature of most clinical examination schemes. It measures retention or immediate memory, which is justifiably considered to be a significant aspect of mental capacity and one which is especially important clinically because of its close relationship to mental impairment. The test has obvious technical advantages, such as brevity of administration, lack of need for test materials and the objective character of the patient's performance.

Nevertheless, while it is a useful single test, both clinical experience and experimental observations indicate that it cannot be considered to be in itself an adequate measure of retentive capacity and that to make a global judgment concerning a patient's retentive capacity on the basis of this test alone, as is so often done, is quite unwarranted. Clinical experience shows that a poor performance on the auditory-vocal digit span test is by no means necessarily indicative of defective retentive capacity. It is well known that emotional tension can significantly impair performance on the test. Indeed, continued experience suggests that it is a test which is unusually sensitive to emotional influences. Consequently, a poor performance in a tense patient does not permit unequivocal interpretation. The poor performance might be due to emotional disturbance; yet one has no evidence that this is necessarily the case. The whole performance, therefore, must be discounted as neither indicating nor ruling out impairment in retention. Since the possibility of emotional disturbance should be considered in all instances of

defective performance on the test, even when emotional tension may not be obvious, defective performance is always open to question unless it is supported by defective performances on other retention tests. In addition, one observes that a certain proportion of normal persons who exhibit no defects in the performance of other mental tasks or retention tests do poorly on this test. The reasons for these defective performances on the part of some normal subjects are not well established and can be counted only as the expression of the range of "individual differences" to be found in the measurement of any trait. Finally, the inadequacy of a single retention test like the auditory-vocal digit span is quite evident when one considers the frequently specific nature of neuropathologic disabilities. A patient's "auditory memory" may be intact at the same time that his "visual memory" is defective. His performance on a retention task involving speech as the motor response may be adequate, while the same task involving graphic activity as the motor response evokes a defective performance.

In this respect, four characteristics of the auditory-vocal digit span test which define its specific nature and which allow for "normal" variations in efficiency in respect to each characteristic should be mentioned: (1) The sensory component is auditory; (2) the motor component is vocal; (3) the material to be retained (numbers) is of a symbolic nature; (4) the test is an "interpersonal" task, involving a constant vocal exchange between patient and examiner.

Experimental psychologic investigation has indicated that when a number of retention tests are given to a group of subjects, the intercorrelations of the scores are not high enough to warrant the substitution of one test for another. Statistical analysis of test results² have yielded evidence for the existence of an "immediate memory factor," but as yet an adequate single test for the valid assessment of this "immediate memory factor" has not been devised. The practical implications of the experimental work on the problem are clear. In the present state of knowledge of memory functions and of mastery of

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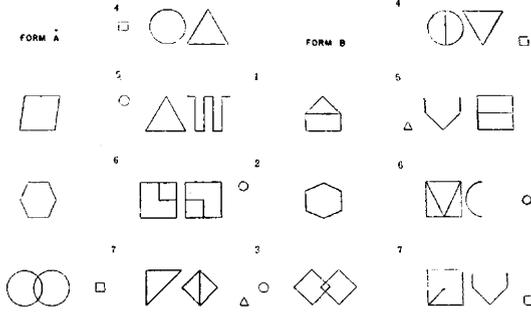
1. Jacobs, J.: Experiments on "Prehension," *Mind* 12:75-79, 1887.

2. Thurstone, L. L.: *Primary Mental Abilities*, Psychometric Monograph, no. 1, Chicago, University of Chicago Press, 1938.

the technic of their measurement, one cannot depend on one test alone to give a valid index of a patient's retentive capacity.

The retention test which I have devised is a "memory for designs" test, the aim of which is to supplement the auditory-vocal digit span test as a measure of retention. In its construction certain conditions were kept in mind:

1. The test should be brief, so that it can be conveniently employed in a test battery of re-



Visual retention test (Benton).

asonable length. This condition is considered to have been fulfilled, since the total time required for administration is four minutes.

2. The test should involve sensorimotor components which are different from the auditory-vocal digit span test. This it does in that it utilizes vision as the sensory component and drawing as the motor component.

3. The material to be retained should be of a nonsymbolic nature. This aim is accomplished by utilizing abstract designs rather than numbers, letters, words or pictures.

4. The test should be a less "interpersonal" task than the auditory-vocal digit span test. This condition is fulfilled in that there is no necessity for conversation between patient and examiner after the initial instructions have been given. The patient does not "talk to" the examiner in giving his response but works alone, thereby making the task more impersonal than the digit span test.

5. The test should be of such a degree of difficulty that normal persons rarely do poorly on it, thereby enhancing the diagnostic value of defective performance on the test. The normative data to be presented here indicate that this condition has been fairly well fulfilled.

6. Equivalent forms of the test should be available, so that a patient may be examined with a minimum of practice effect.

DESCRIPTION OF THE TEST

The visual retention test (figure) consists of seven cards, 5 inches by 8 inches (12.7 by 20.3 cm.), on which one or more designs have been drawn in india ink. The

cards are roughly graded in difficulty, the easier ones being presented first. The larger, central, figures have a maximum height and width of 2 inches (5 cm.). The smaller, peripheral, figures have a maximum height and width of 0.5 inch (1.3 cm.). Two sets (forms A and B) of seven cards each have been constructed.

Administration.—The patient is given blank sheets of paper, preferably 5 inches by 8 inches, and a pencil. He is told that he will be shown a design for ten seconds and that when it is removed he is to draw the design. A separate sheet of paper is used for each drawing. Each card is presented without comment. The patient's performance may be praised.

Scoring.—The scoring standards have been made extremely lenient, since one is interested not in the patient's drawing ability but in his capacity to retain momentarily a visual impression. Any reproduction which the examiner can consider an essentially correct reproduction, in spite of minor distortions, is counted as a success. A manual of directions, including specific scoring samples, has been written in connection with the test. My experience has been that with the aid of these scoring samples practically perfect agreement in scoring between different raters is achieved. The scoring of a single reproduction is on an "all or none" basis, being graded as adequate or inadequate. Since there are seven cards, scores may range from 0 to 7.

NORMATIVE DATA

The accompanying table shows the distribution of scores for the group of 160 subjects on whom the test was standardized. The subjects were, with a few exceptions, patients at a Naval hospital. They were almost all men, there being only 5 women in the group. The ages ranged from 17 to 51 years, the median age being 22

Distribution of Scores of One Hundred and Sixty Subjects on the Visual Retention Test

Group	No. of Sub-jects	Form	Score							Me-dian		
			0	1	2	3	4	5	6		7	
Superior.....	10	A	..	..	..	..	..	1	6	3	6.2	6
Intelligence....	14	B	..	..	..	..	1	2	7	4	6.0	6
Average.....	35	A	..	..	..	..	1	11	17	6	5.8	6
Intelligence....	35	B	..	..	..	..	1	11	14	8	5.8	6
Dull average....	10	A	..	..	..	1	..	5	3	1	5.3	5
Intelligence....	10	B	..	..	..	..	4	4	..	2	5.0	5
Borderline....	13	A	..	..	1	3	6	2	1	..	3.9	4
Intelligence....	12	B	..	..	1	3	3	4	1	..	4.1	4
Moron.....	10	A	2	..	3	2	2	1	..	..	2.5	2.5
	11	B	1	4	1	4	..	1	..	..	2.1	2

years. Some notion of the character of the group may be gained from the following diagnostic classification:

Diagnosis	No. of Patients
Normal	34
Psychoneurosis	43
Psychopathic personality	42
Mental deficiency, moron.....	21
Epilepsy and related states.....	14
Concussion and head injury.....	6

None of these patients showed evidence of an acquired impairment of intellectual function. In

the table, "superior" intelligence indicates an intelligence quotient of above 109; "average" intelligence, an intelligence quotient of 90 to 109; "dull average" intelligence, an intelligence quotient of 80 to 89; "borderline" intelligence, an intelligence quotient of 70 to 79, and the "moron" level, an intelligence quotient of 50 to 69, these intelligence quotient scores being computed from performance on the Wechsler-Bellevue intelligence test.

The following observations, based on inspection of the table may be made:

1. A close correlation between intelligence level and performance on the visual retention test is evident.
2. Forms A and B are practically equivalent. For the groups with superior intelligence one finds mean scores of 6, or slightly above 6, and median scores of 6. The groups with average intelligence make mean scores slightly below 6 and median scores of 6; the groups with dull average intelligence make mean and median scores of about 5, and the groups with borderline intelligence make mean and median scores of 4. The moron groups make mean and median scores of 2.5 or below.
3. Low scores are rarely made by persons of adequate intelligence. Of the 94 subjects of average and superior intelligence, only 1 made a score as low as 3. Conversely, good scores are rarely made by persons of defective intelligence. Of the 21 subjects with mental deficiency, moron level, not a single person attained a score as high as 6.

On the basis of the normative data, the following interpretations have been assigned to the test scores:

Score	Interpretation
7	High average
6	Average
5	Low average
4	Subnormal, "borderline"
Below 4	Defective

Performances of Patients with Cerebral Lesions.—One form or the other of the visual retention test was given to a group of 16 patients who were referred for psychologic examination because of suspected mild intellectual impairment associated with an organic pathologic process and in whom positive evidence of impairment of intellectual function of varying degree was found. Of these 16 men, 2 made average scores (6); 5 made low average scores (5), and the remaining 9 made scores below the average range (4 or less). The introduction of the visual retention test into the psychologic examination served a useful purpose in defining the extent and the

degree of the impairment. In these cases, the auditory-vocal digit span test, because of its sensitivity to tensional and emotional influences, frequently gave results which were of equivocal interpretive value. These officers and men, most of whom were career men and eager to remain in the Naval service and none of whom showed obvious impairment, typically evinced an attitude of considerable anxiety in their intense desire to do well on the mental tests. On the auditory-vocal digit span test, as on other tests, their postural set tended to be one of marked "concentration" and tension. This attitude, which might possibly facilitate performance on some mental tests, is certainly not conducive to good performance on the digit span test, which requires for optimal performance a certain degree of relaxation and a receptive attitude on the part of the subject. On the other hand, performance on the visual retention test, being relatively insensitive to emotional influences, could be interpreted much more readily. As the normative data show, poor performance on the part of subjects with unimpaired intellectual function is rare. Consequently, a poor performance on the visual retention test, in combination with a poor performance on the digit span test, served to establish the conclusion that a defect in retention of considerable scope did in fact exist, a conclusion which could not justifiably be made on the basis of the digit span performance alone. The combination of a good performance on the visual retention test and a poor performance on the digit span test served to indicate that at least a general defect in retention was not present. If, on the basis of general observation of the patient and of other test performances, the examiner was inclined to doubt the validity of the results of the digit span test, the adequate performance on the visual retention test would support the impression that the retentive capacity of the patient was unimpaired. The combination of a poor performance on the visual retention test and a good performance on the digit span test would indicate that visual retention alone was defective, a type of impairment not infrequently encountered in patients with cerebral lesions. Finally, the combination of adequate performances on the two tests would definitely establish the absence of an immediate memory defect.

In summary, it can be reported that a majority of patients suffering from mild impairment of intellectual function on an organic basis can be expected to show subnormal efficiency on the visual retention test and that the test has shown

itself to be of value in defining the scope of the impairment and in complementing the performance on the digit span test.

REPORT OF CASES ILLUSTRATING USE OF VISUAL RETENTION TEST³

CASE 1.—Application of the visual retention test in the case of a 26 year old Marine recovering from a shrapnel wound in the left parietal area may be noted to indicate how the test can aid in arriving at a judgment concerning the mentality of a patient with a language disorder. At the time of examination the patient no longer showed an overt speech disturbance, although previously he had shown marked anomia and "word-finding" disturbance. At this time he showed an incomplete homonymous hemianopsia, which was rapidly clearing, pronounced acalculia (but no finger agnosia or right-left disorientation) and impairment in reading and writing. His reading was slow, labored and fatiguing. He could not write to dictation but could copy written material. Performance on information and vocabulary tests was average and indicated that the pretraumatic intellectual level had been average, a conclusion in accord with his educational and social history. On the digit span test, he could repeat only 4 digits and reverse only 3 digits. On an "object memory" test, involving the verbal recall of objects which had been exposed to him, his performance was also notably defective. On the basis of the results of these two tests alone one might have concluded that "retentive capacity in general" was considerably impaired and that his mental disabilities extended beyond the language sphere. However, on the visual retention test he made a score of 5, corresponding to a low average performance. Thus, given a retention task in which speech was not involved as the motor element in response, his performance was fairly adequate, a fact which had obvious bearing on the question of whether intellectual impairment was present in addition to the disturbance in the formation, expression and utilization of symbols.

In addition, the results clearly suggested that, although the overt speech disorders (anomia, word-finding disturbance) were no longer apparent, a language disturbance was still present. This, and not defective "basic retentive capacity," appeared to account for the poor performance on the two retention tests involving speech as the motor element in response and symbols as the content of the response. In view of the marked agraphia, the adequate performance on the visual retention test is especially noteworthy.

CASE 2.—A pharmacist's mate, aged 20, sustained a bullet wound in the left frontoparietal region, with immediate flaccid paralysis of the right arm and both legs and complete expressive aphasia for twenty-one days. At the time of psychologic examination, approximately three and a half months after his injury, he showed a spastic right hemiparesis, the paralysis being more severe in the arm than in the leg or face. No sensory disturbances or hemianopsia was present. There was some residual aphasia in the form of hesitant speech and occasional blocking but no receptive aphasia or anomia. Psychologic examination indicated superior pretraumatic intelligence. Performance on tests of arith-

3. The 2 patients whose cases are reported here are not included in the group of 16 persons with cerebral lesions discussed in the preceding section.

metical reasoning and calculation was extremely unstable. One minute the simplest calculation could not be made, and a few minutes later much more difficult calculations would be done readily. Abstract reasoning ability was unimpaired. On the digit span test he could repeat only 5 digits and reverse only 3 digits. On an object memory test, involving the verbal recall of representations of objects seen, performance was defective. However, on the visual retention test, in drawing with the left hand, performance was average (score 6). Two aspects of the performance are noteworthy: 1. As in case 1, the language disturbance evidently led to disturbed performance on retention tests involving speech and containing symbolic material, such as the digit span and the object memory test. The visual retention test, involving drawing as the motor response and containing nonsymbolic material, was done well, indicating the limitation of his defects to the language sphere. 2. Despite the motor defect and the necessity for drawing with the left hand, performance on the visual retention test was adequate, indicating that the scoring standards are sufficiently lenient to insure that the test is in no sense one of drawing ability.

Performances of Patients with Severe Mental Disorder.—In this group of 17 patients were included psychotic patients showing impairment of intellectual function, disturbed psychopaths and 2 patients with hysterical pseudodementia associated with amnesia. Performance on the visual retention test was typically poor, only 1 patient achieving an average score (6), 2 patients making a low average score (5) and the rest making scores of 4 or less. The digit span performance of these patients, likewise, tended to be poor.

Performance of Older Subjects.—The question whether there is a decline in performance on the visual retention test on the part of older persons has not been systematically studied. Within the age range (17 to 51 years) of the normative group, inspection of the data shows no decline in efficiency with age. To what extent persons in the fifties and sixties would show a decline in efficiency must remain an open question until an adequate sample of that population is investigated. My expectation, based on what is known about the "normal" decline of retentive ability with age, is that persons in the 51 to 60 year age group would show a slight decline in test performance and that persons over 60 years of age would show a more pronounced loss in retentive ability.

Sex Differences in Performance.—This question has not been investigated, since the normative group was predominantly male. The 5 women of the group were of either average or superior intelligence, and all made scores within the average range. Significant sex differences in performance on the test are not expected, but this question should be systematically studied.

SUMMARY

A brief test of visual retentive capacity, available in two equivalent forms, has been developed for use in the mental examination of patients as a supplement to the auditory-vocal digit span test.

The test involves sensorimotor components which are different from those involved in performance on the digit span test; the material to be retained is of a nonsymbolic nature, and performance on the test is relatively insensitive to emotional and tensional influences.

The normative data indicate a close relationship between the visual retention test score and the level of general intelligence.

Investigation of the performances of patients with cerebral lesions indicates that the test is of value in defining the scope and severity of intellectual impairment.

Normative scores have been developed on the basis of the standardization data, and a manual of directions for administration and interpretation of the test has been developed.⁴

4. The test materials and a manual of directions for constructing, administering and scoring the test are available on request to Dr. A. L. Benton, Student Personnel Bureau, College of the City of New York, Convent Avenue and One Hundred and Fortieth Street, New York.