XX. A MEMORY TEST WITH SCHOOL CHILDREN¹

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THE PROBLEM STATED

With a view to determining the power of recall in school children, a series of tests were made. It was sought to ascertain the effect upon the power to recall when:

1. A number of objects are displayed (*a*) singly; (*b*) three together.
2. The objects chosen interest, we might suppose, particularly (*a*) the boy's mind; (*b*) the girl's mind.
3. The subjects tested are of different school grades.
4. The subjects tested are of different sex.

OBJECTS CHOSEN

Fifteen objects were selected as follows: pocket knife, roll of string, marble, watch, key, flat-iron, threaded needle, thimble, scissors, doll, pencil, notebook, two-cent stamp, five-cent nickel, and match.

These objects fall into three groups: First, those that interest particularly the boys and are handled by them in their daily routine. These are the first five objects listed. Second, those that might be expected to interest the girls. These are the second five objects named. Third, those that are of equal interest to both sexes. These constitute the final five objects. All of the objects are found constantly in the child's environment. Choice was made of objects that were not too greatly different in size.

THE SUBJECTS

The subjects were chosen from the third, fifth and eighth grades, sixty from each grade, one hundred eighty pupils, all told. They were equally divided, thirty boys and thirty girls from each grade. They represented several different

¹ From the Psychological Laboratory of the University of California.

schools, in various sections of the city where the tests were made.

APPARATUS USED

The apparatus for the tests was simple: A circular disc of wood, one-half inch thick and eighteen inches in diameter served as a stand upon which, near its outer edge, the objects were arranged at equal distances apart. A second disc of like thickness and twenty-four inches in diameter, had an opening whose size could be varied as desired. The larger disc was placed four inches above the smaller, which rested flat upon a desk or table. The upper disc was held in its horizontal position and made to revolve over the lower disc as a wheel revolves on an axle. This was accomplished by means of a rectangular block having either end cut to a step-cylinder and housed or shouldered into the inner faces of the two discs at their centers.

ARRANGEMENT OF OBJECTS

Those five objects supposed to be more familiar to the girls were placed in sequence—the threaded needle, flat-iron, thimble, doll and scissors. In the same way those objects pertaining chiefly to the boys were arranged in sequence—marble, knife, watch, key and roll of string.

MODES OF DISPLAY

During the tests there were two modes of display. First, the objects were shown in such a way that, at all times, three were visible, while as each new object entered this group, one of the older members of it dropped out. Second, they were displayed singly. Any one subject was tested with only one mode of display.

METHOD OF PROCEDURE

Each subject was allowed one minute for observation of the fifteen objects, whatever was the mode of display. In the first test, the subject was placed directly in front of the cut-out sector and, as the upper disc revolved, the objects came into view, three at a time. The subject moved with

the disc, thus keeping directly in front of the opening. In the second test, the same order of arrangement was maintained, but the opening in the disc revealed only one object at a time. By allowing three seconds for each exposure, with one second interval, a total of one minute was given as in the other test.

In every instance note was made of the object at which the observation was begun. The immediate recall was tested at the close of the experiment by having the pupil name all the objects he could remember. A list of these objects was recorded by the operator in the order in which the pupil named them. The subject was also given a sheet of paper having a circle described upon it and corresponding to the disc. Upon this circle he was asked to locate the objects in the order in which they were placed on the disc. Any additions to the list of objects originally recalled were placed to the observer's credit. Record was then made of the total number of objects recalled by each pupil, out of a possible fifteen; of the order of recall, that is, the sequence in which the objects were named; and of the order preserved in placing the objects on the circle. An object is said to be in a '*correct*' position when it is located upon the circle in a position exactly corresponding to its original position on the disc. Two objects were said to be in a '*relatively*' correct position when they simply changed places in location,—were transposed. Or, if two objects in adjacent positions on the disc were given a corresponding location upon the circle, but not arranged properly as regards other objects in the group, the placing was said to be relatively correct. As only objects not included in the list of those correctly placed are included in the '*relatively correct*' column, the average for the former is usually greatly in excess of the latter. Whenever the average for correct placing is relatively high, the average for relative placing is considerably lessened. There are twenty judgments when the objects are displayed singly and twenty when they are displayed three together.

THE RESULTS

Table I shows the results of the test in the three grades with the two methods of exposure.

These results are then analyzed in several tables that bring out: (1) The effect of the different methods of display without regard to grade, sex or arrangement of objects; (2) The effect of the particular grade of pupil upon total recall, correct and relative placing and the like; (3) The effect of sex upon total recall, the recall of boys' and girls' groups,¹ etc.

TABLE I

	Sex	Av. No. Recalled	Av. No. Correctly Placed	Av. No. Relatively Placed	Av. No. Recalled, Boys' Group	Av. No. Recalled, Girls' Group	M.V. of Total Recalled
Grade 3:							
One at a time	Boys	7.4	5.7	.7	2.9	2.7	1.17
	Girls	8.1	5.4	.9	2.6	3	1.5
	Both	7.75	5.55	.8	2.75	2.85	1.61
Three at a time							
	Boys	9.1	6.4	.9	2.9	3.7	1.92
	Girls	8	5.5	.7	3.4	3	1.4
	Both	8.55	5.95	.8	3.15	3.35	1.66
Grade 5:							
One at a time							
	Boys	10.5	3	2.5	3.6	3.3	1.7
	Girls	9.2	2.3	3.4	2.8	3.3	1.04
	Both	9.85	2.65	2.95	3.2	3.3	1.37
Three at a time							
	Boys	9.5	3.7	2.9	2.9	3.2	1.4
	Girls	9.5	2.4	3.7	3.3	3	1.1
	Both	9.5	3.05	3.3	3.1	3.1	1.25
Grade 8:							
One at a time							
	Boys	9.2	5.7	1.9	2.7	3.4	1.04
	Girls	9.6	7.1	.4	3.8	3.2	1.24
	Both	9.4	6.4	1.15	3.25	3.3	1.14
Three at a time							
	Boys	10	6.4	2.3	3.1	3.4	1.4
	Girls	10.1	6.6	2.1	3.1	3.7	1.5
	Both	10.05	6.5	2.2	3.1	3.55	1.46

Table II. shows the collective results with the two methods of display.

TABLE II

Method of Display	Av. No. Recalled	Av. No. Correctly Placed	Av. No. Relatively Placed	Av. No. Recalled, Boys' Group	Av. No. Recalled, Girls' Group	M.V. of Total Recall
Singly	9	4.87	1.633	3.07	3.15	1.37
Three at a time	9.37	5.166	2.1	3.12	3.33	1.46

¹ The letters G. and B. will be used throughout as referring to the objects spoken of as the girls' and boys' group respectively.

The display of the objects three at a time gives an advantage in the average number of objects recalled, as well as in the average number correctly placed. When shown three together the relative placing also is better than when the objects are displayed singly. The tendency to recall the *G*. or *B*. group receives very slight advantage in any one method of display over another. The M.V. of total recall varies only slightly in the two methods.

Table III. shows comparative results in grades three, five and eight.

TABLE III

Grade	Av. No. Recalled	Av. No. Correctly Placed	Av. No. Relatively Placed	Av. No. Recalled, Boys' Group	Av. No. Recalled, Girls' Group	M.V. of Total Recall
3	8.15	5.75	.8	2.95	3.1	1.63
5	9.67	2.85	3.12	3.15	3.2	1.31
8	9.72	6.45	1.67	3.17	3.4	1.30

The pupils of the fifth grade show a marked superiority over those of the third grade in the average number recalled. The eighth grade is not greatly in advance of the fifth in this particular. In correct placing, the third grade is almost abreast of the eighth, while the fifth grade drops back to one half the showing made by the third. In relative placing, the fifth grade students far excel those of the third and are much superior to the eighth. The fifth and eighth grades show about equal power in recall of the *B* group, while the third grade makes nearly as good a showing. In every grade the average for recall of the *G* group is slightly better than that of the *B* group.

Table IV. shows the effect of sex in all grades.

TABLE IV

Sex	Av. No. Recalled	Av. No. Correctly Placed	Av. No. Relatively Placed	Av. No. Recalled, Boys' Group	Av. No. Recalled, Girls' Group	M.V. of Total Recall
Boys	9.28	5.15	1.86	3.02	3.28	1.43
Girls	9.08	4.88	1.86	3.16	3.2	1.30

Table V shows the relation of boys to girls in the different grades.

TABLE V

Grade	Sex	Av. No. Recalled	Av. No. Correctly Placed	Av. No. Relatively Placed	Av. No. Recalled, Boys' Group	Av. No. Recalled, Girls' Group	M.V. of Total Recall
3	Boys	8.25	6.05	.8	2.9	3.2	1.55
	Girls	8.05	5.45	.8	3	3	1.45
5	Boys	10	3.35	2.7	3.25	3.25	1.55
	Girls	9.35	2.35	3.55	3.05	3.15	1.07
8	Boys	9.6	6.05	2.1	2.9	3.4	1.22
	Girls	9.85	6.85	1.25	3.45	3.45	1.38

In the third and fifth grades, the boys have a slight advantage over the girls in the total number recalled and in the number correctly placed. The objects composing the *G* group are recalled somewhat better by each sex. The ratio between the recall by girls and boys of the *B* group and the *G* group is only slightly different from the ratio between girls and boys in the total recall.

CONCLUSIONS FROM THE STUDY

The results of the various experiments would seem to justify the following conclusions:

1. Recall is stronger when the objects are seen three at a time than when shown singly.
2. The average for total recall shows a considerable increase from the third to the fifth, with an almost negligible increase from the fifth to the eighth grades. This difference is emphasized when we consider that the age-difference between the fifth and eighth grade was approximately twice as great as that between the third and fifth. In other words, ability to memorize or to recall does not increase regularly with advance in age or experience.
3. The total average of recall for all grades and with all methods of exposure of objects shows the girls not to be superior to the boys. This is not in accord with the usual outcome of experiments in memory. No clear difference is discernible between the boys and the girls in the attraction exerted by the so-called boys' group and girls' group of objects; for both sexes the girls' group was slightly more attractive.