

SOME OBSERVATIONS ON THE LEARNING OF SENSIBLE MATERIAL.

JOHN A. DELL, M.Sc.,

Assistant Master, Sexey's School, Bruton, Somerset, England.

SUMMARY.

Three experiments were made on the Learning of Sensible Material with the object of discovering whether the position of facts in a series has any such influence on their likelihood of being remembered as has been shown to be the case with nonsense material. The material used in this experiment consisted of (1) a lecture entitled "Fifty Years of Punch," (2) a lesson on buds, (3) two courses of lessons, one in chemistry and the other in nature study, extending over a term of three months.

In all cases it was found that position in the series had negligibly small influence upon remembrance in comparison with effects due to other causes.

THE "LECTURE" EXPERIMENT.

A lecture was given at Sexey's School, Bruton, on "Fifty Years of Punch," illustrated by lantern slides. The lecture presented a series of slides taken from pictures which had appeared in Punch, and each slide was briefly described by the lecturer. Attendance at the lecture was purely voluntary, but a large proportion of the scholars were present. The lecture lasted an hour and a half.

Eight days later those who had been present at the lecture were asked to submit themselves to a memory test. Thirty of those who had attended expressed their willingness to do so, and they were then asked to write down in as brief a manner as possible a recognizable description of each of the slides they had seen. In most cases a single phrase was enough to indicate whether a particular slide had been remembered or

not, but in a few ambiguous cases the writers were asked privately for a fuller verbal explanation. In this way the number of individuals who remembered each slide was determined with practical certainty. The following table shows the numbers of individuals who recalled each slide of the series. No frequencies are recorded against numbers 8, 12, 45, 47, 49, 53, 58, 61, 64, 67, 72, 73 on account of an ambiguity in the printed list of slides by means of which these results were corrected.

TABLE I.—*Frequency with which slides of Punch lecture were remembered.*

| No. | Frequency | No. | Frequency | No. | Frequency | No. | Frequency |
|-----|-----------|-----|-----------|-----|-----------|-----|-----------|
| 1 | 13 | 21 | 8 | 41 | 6 | 61 | .. |
| 2 | 14 | 22 | 12 | 42 | 9 | 62 | 4 |
| 3 | 24 | 23 | 14 | 43 | 2 | 63 | 4 |
| 4 | 9 | 24 | 18 | 44 | 2 | 64 | .. |
| 5 | 12 | 25 | 8 | 45 | .. | 65 | 3 |
| 6 | 15 | 26 | 6 | 46 | 0 | 66 | 5 |
| 7 | 12 | 27 | 2 | 47 | .. | 67 | .. |
| 8 | .. | 28 | 7 | 48 | 1 | 68 | 1 |
| 9 | 7 | 29 | 11 | 49 | .. | 69 | 5 |
| 10 | 11 | 30 | 7 | 50 | 3 | 70 | 5 |
| 11 | 4 | 31 | 3 | 51 | 3 | 71 | 1 |
| 12 | .. | 32 | 21 | 52 | 7 | 72 | .. |
| 13 | 8 | 33 | 1 | 53 | .. | 73 | .. |
| 14 | 14 | 34 | 5 | 54 | 6 | 74 | 0 |
| 15 | 2 | 35 | 1 | 55 | 3 | 75 | 6 |
| 16 | 12 | 36 | 6 | 56 | 10 | 76 | 2 |
| 17 | 16 | 37 | 7 | 57 | 1 | 77 | 13 |
| 18 | 17 | 38 | 4 | 58 | .. | 78 | 0 |
| 19 | 30* | 39 | 10 | 59 | 0 | 79 | 6 |
| 20 | 9 | 40 | 10 | 60 | 7 | 80 | 2 |

*Number 19 was described to those who were being tested as an example of the way in which results were to be written down. It accordingly appears on every paper.

COMPARISON OF THIS RESULT WITH THE RESULT OF LEARNING A NONSENSE SERIES.

Bolton¹ has shown that of a series of figures arranged in a meaningless order, those near the ends of the series are most likely to be remembered. He writes on this point: "This will be true of any series of successive ideas. They are permanent in inverse order as they are removed from the beginning, except the last two or three, which are permanent in their order from the last."

The series of ideas forming the subject of this experiment shows, like Bolton's, a gradual falling off as we pass along it

(1) American Journal of Psychology, iv. 1891, p. 362.

from the beginning with a rather questionable rise again at the end. This is more clearly seen if the results are grouped so as to show the average frequency of positions of the curve lying between successive minima:—

TABLE II.

| | | | | | | | |
|-------------------|------|-------|-------|-------|-------|-------|-------|
| Group | 1-15 | 16-27 | 28-35 | 36-46 | 47-59 | 60-74 | 75-80 |
| Average frequency | 11.2 | 11.1 | 7.0 | 5.6 | 3.8 | 3.5 | 4.8 |

It is certain, however, that there are other causes at work which produce fluctuations much greater than any effect due merely to position.

THE LESSON EXPERIMENT.

A lesson on buds was given independently to two forms, which contained 16 and 21 boys, respectively. The facts of the lesson were derived from observations made by the class under the direction of the teacher. The facts may be classed in three groups, and in giving the lessons the groups of facts were arranged in different orders. The following scheme shows the order in which the groups of facts were taken in the two classes:

FORM I—16 BOYS.

1. Arrangement of Scales.
2. Contents of buds.
3. Arrangement of buds on shoot.

FORM II—21 BOYS.

1. Arrangement of buds on shoot.
2. Arrangement of Scales
3. Contents of bud.

Each class was tested by a short series (10) of oral questions at its next meeting. These questions were framed with the most scrupulous care to avoid suggesting answers (which is one reason why so few were used), and were asked in the same order on both occasions. Questions were chosen which could be answered by a single word or a short sentence.

The answers were arranged in three groups, according to the section of the lesson with which they dealt, and the percentage of frequency of correct answers was determined. In this way the following table was computed:

TABLE III.

| Subject of Question. | Form I. | | Form II. | |
|-----------------------|---|--|---|--|
| | % Frequency of correct answer to each question. | Average % Frequency of correct answer to question in each group. | % Frequency of correct answer to each question. | Average % Frequency of correct answer to question in each group. |
| Scales of single bud. | { 37.5 37.5 } | 37.5 | { 89.5 19.1 } | 54.3 |
| Contents of bud. | { 68.9 87.5 37.5 43.8 } | 59.4 | { 89.5 76.2 66.7 38.6 } | 67.8 |
| Arrangement of buds. | { 62.5 43.8 18.8 31.3 } | 39.1 | { 89.5 89.5 33.3 38.6 } | 62.7 |

Inspection of the right-hand columns under Form I and Form II, respectively, shows that the probability of obtaining a correct answer is greatest for a question in Section II, next greatest for Section I and least for Section III, although the subject-matter of these sections occupied different positions in the lessons given to the two forms. The fact that pupils of Form II are more likely to get a correct answer in any section than those of Form I is explained by their greater age and by their previous training, since a number of them had already passed through Form I.

These results strongly confirm those of the "lecture" observations. When a series of facts having a rational relation to one another is learnt, the chance of their being remembered depends to a negligible extent upon the order in which they are presented, and much more upon entirely different causes.

EXPERIMENTS LASTING FOR A WHOLE TERM.

Form III was examined on a single term's work in chemistry by means of carefully-arranged short questions of the same character as those suggested in the last experiment. Forms I and II, in both of which the pupils had been doing the same work, were examined in the same way in nature study. The answers were then corrected and the results arranged in the order in which the facts had been dealt with during the term. These results are shown in Tables IV and V. The frequencies indicated are *actual*, not percentage, frequencies.

TABLE IV.—*Frequency with which facts dealt with in a course of Nature Study lessons were remembered by Forms I and II.*

| No. of Question. | Frequency of Correct Answer. | No. of Question. | Frequency of Correct Answer. | No. of Question. | Frequency of Correct Answer. | No. of Question. | Frequency of Correct Answer. | No. of Question. | Frequency of Correct Answer. |
|------------------|------------------------------|------------------|------------------------------|------------------|------------------------------|------------------|------------------------------|------------------|------------------------------|
| 1 | 34 | 11 | 36 | 21 | 6 | 31 | 33 | 41 | 35 |
| 2 | 37 | 12 | 36 | 22 | 19 | 32 | 29 | 42 | 19 |
| 3 | 31 | 13 | 34 | 23 | 24 | 33 | 24 | 43 | 26 |
| 4 | 32 | 14 | 36 | 24 | 28 | 34 | 27 | 44 | 29 |
| 5 | 24 | 15 | 35 | 25 | 28 | 35 | 33 | 45 | 15 |
| 6 | 17 | 16 | 31 | 26 | 34 | 36 | 28 | 46 | 35 |
| 7 | 27 | 17 | 26 | 27 | 34 | 37 | 26 | 47 | 33 |
| 8 | 36 | 18 | 30 | 28 | 27 | 38 | 25 | 48 | 9 |
| 9 | 7 | 19 | 19 | 29 | 29 | 39 | 9 | 49 | 32 |
| 10 | 25 | 20 | 30 | 30 | 33 | 40 | 33 | 50 | 32 |

TABLE V.—*Frequency with which facts in a course of Chemistry lessons were remembered by Form III.*

| No. of Question. | Frequency of Correct Answer. | No. of Question. | Frequency of Correct Answer. | No. of Question. | Frequency of Correct Answer. | No. of Question. | Frequency of Correct Answer. | No. of Question. | Frequency of Correct Answer. |
|------------------|------------------------------|------------------|------------------------------|------------------|------------------------------|------------------|------------------------------|------------------|------------------------------|
| 1 | 33 | 11 | 28 | 21 | 21 | 31 | 14 | 41 | 15 |
| 2 | 27 | 12 | 25 | 22 | 25 | 32 | 23 | 42 | 13 |
| 3 | 28 | 13 | 15 | 23 | 33 | 33 | 12 | 43 | 27 |
| 4 | 21 | 14 | 17 | 24 | 23 | 34 | 28 | 44 | 29 |
| 5 | 33 | 15 | 14 | 25 | 28 | 35 | 19 | 45 | 16 |
| 6 | 28 | 16 | 28 | 26 | 26 | 36 | 18 | 46 | 9 |
| 7 | 22 | 17 | 13 | 27 | 9 | 37 | 16 | 47 | 22 |
| 8 | 24 | 18 | 19 | 28 | 22 | 38 | 10 | 48 | 21 |
| 9 | 17 | 19 | 16 | 29 | 32 | 39 | 25 | 49 | 26 |
| 10 | 18 | 20 | 13 | 30 | 15 | 40 | 26 | 50 | 13 |

Tables VI and VII present the results grouped so as to show the average frequency of portions of the curve lying between successive minima, as in Table II.

TABLE VI.—*Grouping of the Results of Table IV.*

| | | | | |
|-----------------------------|------|-------|-------|-------|
| Group | 1-9 | 10-21 | 22-39 | 40-50 |
| Average frequency | 27.2 | 28.8 | 26.6 | 27.1 |

TABLE VII.—*Grouping of the Results of Table V.*

| | | | |
|-----------------------------|------|-------|-------|
| Group | 1-17 | 18-38 | 39-50 |
| Average frequency | 23 | 20.1 | 20.2 |

These results agree perfectly with the previous ones. In both cases there is only the slightest indication (in one case none) that special parts of the series are remembered better than others in virtue of their position. In any case such differences as do occur are completely insignificant in comparison with larger fluctuations due entirely to other causes.

When a series of meaningless syllables is learnt they are connected in the mind by associations depending almost entirely on their contiguity in space or time. In rational learning, on the other hand, the associations formed depend almost entirely on associations by similarity with various facts, many of which form no part of the memorized series at all, but have been present in consciousness before. The learner, in fact, builds up in his own mind a number of series concurrently, and when a new fact is presented to him he places it in what seems to him its correct position in some series already in his mind.

Other things being equal, the beginning and the end of a lesson are the best places for facts which have to be remembered; generally speaking, however, other things are *not* equal, and it is not worth while to alter the natural sequence of the facts in order to bring any particular fact to the beginning or end.