A FURTHER ANALYSIS OF REASONING IN RATS

I. The Influence of Trace-Aggregation on Problem Solving[1]

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INTRODUCTION

In a series of studies on reasoning, Maier (1929) (1932) has attempted to measure the ability to combine two or more isolated experiences in such a manner as to reach a goal. Tests were formulated in which the animal was required to construct a round-about route to food from parts of separate past experiences. In some cases the past experience involved the learning of two pathways. When food was placed at the end of one of these and the animal experienced food at the terminal point, this experience of food was adequate to produce a preference for one of the paths. The experience of exploring the pathways and tables produced no preference, but the addition of the experience of eating food at the end of one of them (after being placed at this point, but without running there) resulted in a preference for the path which led to it. Both training on the pathways and the separate experience of food at the end of one were essential to finding the food, and neither alone was adequate.

If we grant that such problems involve the combined effect of two isolated experiences (i.e., the experience of exploring the pathways and the experience of food at a certain place), we may raise the following question: To what extent is the ability to keep experiences isolated or individual essential to the solution of such

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problems? Suppose an animal lacks ability to discriminate. In such a case, isolated experiences would fuse and lose identity, and the essential parts of specific past experiences could not be combined. If the animal does not keep the experience of feeding at a certain place separate from feeding at others, it must necessarily fail the problem. Ordinarily, this would be called confusion. In the tests used, precautions were taken to make the environment sufficiently characteristic so that discrimination on the basis of a single sensory process was not required. Nevertheless, it is possible that the identity of certain past experiences was lost due to changes in memory traces. Koffka (1935) has presented a strong case to show that memory traces form aggregates and thus cause individual identity to be lost.

It is the purpose of the present study to analyze a typical reasoning problem used by Maier (1932) and determine (1) to what extent such aggregations of memory traces are involved, and (2) whether tendency toward confusion is related to the ability to combine isolated experiences.

METHOD

The simple test for reasoning was utilized to make the abovementioned analysis. For a detailed description of this test, see Maier and Schneirla (1935, p. 463). The apparatus consisted of three tables (*X*, *Y*, and *Z*), equally spaced about a center, as in figure 1. Elevated pathways lead from the central point of each of these tables. Each animal explored the pathways and tables thoroughly. An animal was then fed on one of the tables (e.g., *Y*). After a brief feeding period, it was removed to another table (e.g., *X*). When on the starting table (table *X*), the problem for the animal was to get to the food table (e.g., table *Y*), which was one of the two remaining tables (*Y* and *Z*). On one of these the animal had just been fed; both had been previously explored. To return to food (e.g., go from table *X* to *Y*) requires that these two tables retain their identity.

In previous studies, the above procedure was repeated each day, but with a different combination of tables. In this manner, the same kind of test situation was repeatedly presented, and no response to food could be learned.

In the present study, a group of five different tests were given in succession, each test involving a different combination of tables. The starting table of each test was always the food table of the previous test, so that the animal could experience the removal of food from this table. The different test combinations used are given in table 1. If the animals have difficulty

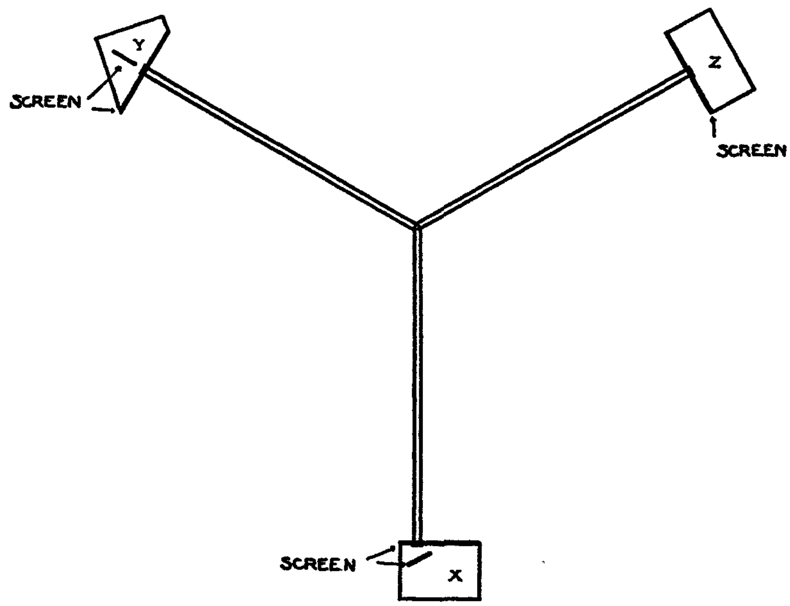

FIG. 1

in retaining the identity of the separate experiences, this succession of tests should lower the score.

SUBJECTS USED

In the main experiments 46 adult (over 150 days in age) male rats were used as subjects. Some of these were subjected to brain operations in order to obtain animals with a lower level of intelligence. An additional group of 23 adult male rats was used on a modified form of the above-described apparatus.

TABLE 1

Test combinations used on three-table problem

TEST GROUP	TEST	STARTING POINT	FOOD PLACE	ALTERNATIVE CHOICE
A	1	*X*	*Y*	*Z*
	2	*Y*	*Z*	*X*
	3	*Z*	*X*	*Y*
	4	*X*	*Z*	*Y*
	5	*Z*	*Y*	*X*
B	1	*Y*	*X*	*Z*
	2	*X*	*Z*	*Y*
	3	*Z*	*Y*	*X*
	4	*Y*	*X*	*Z*
	5	*X*	*Y*	*Z*
C	1	*Y*	*Z*	*X*
	2	*Z*	*X*	*Y*
	3	*X*	*Y*	*Z*
	4	*Y*	*Z*	*X*
	5	*Z*	*X*	*Y*
D	1	*X*	*Z*	*Y*
	2	*Z*	*Y*	*X*
	3	*Y*	*X*	*Z*
	4	*X*	*Z*	*Y*
	5	*Z*	*Y*	*X*
E	1	*Y*	*X*	*Z*
	2	*X*	*Y*	*Z*
	3	*Y*	*Z*	*X*
	4	*Z*	*X*	*Y*
	5	*X*	*Y*	*Z*
F	1	*Y*	*Z*	*X*
	2	*Z*	*X*	*Y*
	3	*X*	*Z*	*Y*
	4	*Z*	*Y*	*X*
	5	*Y*	*X*	*Z*

RESULTS

a. General results

In table 2, the scores made by 46 normal rats are given. The animals were tested on twenty days, and each day five different

TABLE 2

Scores made by rats on first, second, third, fourth, and fifth tests of the day over a period of twenty days

RAT	NUMBER OF CORRECT RESPONSES IN TWENTY GROUPS OF DAILY TESTS				
	First test	Second test	Third test	Fourth test	Fifth test
1	18	19	18	19	20
2	19	19	18	14	18
3	20	19	19	18	19
4	18	17	17	16	15
5	20	20	18	17	18
6	18	17	16	18	19
7	19	17	17	16	18
8	13	14	10	14	12
9	19	18	17	18	13
10	20	18	17	16	17
11	19	15	15	14	14
12	14	16	14	14	12
13	18	14	14	14	14
14	19	19	16	13	17
15	18	17	15	15	15
16	18	20	16	16	16
17	20	20	19	19	20
18	19	14	15	14	18
19	19	17	16	17	18
20	17	18	17	17	18
21	20	16	15	15	15
22	19	19	19	12	16
23	20	20	18	15	11
24	17	18	16	15	14
25	17	18	16	15	14
26	20	20	19	20	17
27	20	18	14	16	15
28	17	18	16	17	19
29	17	19	14	17	15
30	19	18	16	15	17
31	13	19	14	16	16
32	19	18	15	15	17
33	19	19	16	17	15
34	18	18	14	18	18
35	19	20	19	17	17
36	17	15	11	15	14
37	20	18	14	17	18
38	19	19	15	14	16
39	19	17	16	18	14
40	20	19	18	17	16

TABLE 2—*Concluded*

RAT	NUMBER OF CORRECT RESPONSES IN TWENTY GROUPS OF DAILY TESTS				
	First test	Second test	Third test	Fourth test	Fifth test
41	15	19	17	19	15
42	18	19	15	12	16
43	19	18	16	18	16
44	17	15	14	16	18
45	18	17	17	18	14
46	15	17	14	12	9
Average...........	18.17	17.80	15.91	15.97	15.93
P.E. av...........	.168	.192	.175	.173	.223
S.D...............	1.70	1.94	1.77	1.75	2.70
Per cent correct when chance equals 0 per cent.	81.7	78.0	59.1	59.7	59.3
Combined score, per cent correct.	79.9		59.4		
Reduction in score, per cent.........	25.6				

test combinations were used. The correct responses for the first, second, third, fourth, and fifth test of each day are given in separate columns. Since twenty groups of tests were given, the maximum score for any rat is twenty correct runs on each of the five daily tests.

The average number of correct runs for the first test was found to be 18.17; for the second test, 17.80; for the third, 15.91; for the fourth, 15.97; and for the fifth, 15.93. From these averages and the P.E. of the averages, it is apparent that the scores for the first and second tests are approximately equal, and that the scores for the third, fourth, and fifth tests of the day are strikingly equal to each other and reliably different from the scores of the first and second tests. The average for the first two tests is 17.99, and for the last three tests is 15.94.

This difference in score becomes of greater significance when we realize that by pure chance an animal would make 10 correct runs. If we express the score in terms of the per cent of correct runs and reduce a chance score to 0 per cent by dividing the difference between correct and incorrect runs by the total number of runs, then the average score for the first two tests becomes 79.9 per cent correct and that for the last three tests, 59.4 per cent correct; a reduction of 25.6 per cent. In the table, the per cent of correct responses for each of the tests is given, when the chance score is reduced to 0 per cent correct.

From these results, it is apparent that the repetition of tests results in a reduction in score after the second test. Since the reduction is not progressive, it seems that some condition enters the situation after the second test and that this condition remains constant thereafter.

TABLE 3

Relation between score on first and third tests

SCORE ON FIRST TEST	NUMBER OF CASES	SCORE ON THIRD TEST	PER CENT OF REDUCTION IN SCORE
per cent		*per cent*	
100	10	71.1	29.0
90	15	64.0	28.9
80	9	58.0	27.5
70	7	49.0	30 0

b. Relation between ability on test and reduction in score resulting from repeated testing

Since the scores on the first two tests and the last three tests show a marked difference, we must analyze the cause of this difference. That the scores on the first two tests and the last three tests are related is shown by the correlation coefficient of .64 ±.06. The first and third tests show a correlation coefficient of .63 ±.06. We must now determine whether there is an increase in the difficulty of the problem after the first two tests or whether the reduction in score is unrelated to the complexity of the problem. To test this, we may compare the reduction in score for rats showing varying degrees of proficiency on the problem.

In table 3, the rats are grouped according to their score on the first test. Their scores on the third test are given in the third column, and the relative reductions in scores for these groups are shown in the fourth column. It will be seen that for rats making a score between 70 and 100 per cent on the first test the per cent of reduction in score on the third test is approximately constant, being between 27.5 and 30.0 per cent.

Five cases made scores below 70 per cent. If we combine their records for the first two tests, we find they made a score of 55 per cent correct. Their average on the last three tests was 39 per cent. This is a reduction of 29.1 per cent in score and corresponds to that of the other rats.

From these data, we may conclude that the third test, although it becomes more difficult for all rats, does not become relatively more difficult for rats making low initial scores. This raises the question of whether the first and last part of the testing period would show an increase in difficulty if we had more decidedly inferior individuals. Cases of this sort were produced by cortical injury. In table 4, only cases which showed a reduction in score on the first test following cortical injury are included since inferior individuals were required.

From this table it can be seen that both before and after operation these rats show a marked decrease in score after the second test of the day. Before operation, the average score for the first two tests is 86.8 per cent, and that for the last three is 60.3 per cent, a reduction of 30.5 per cent. After operation, these same rats made a score of 55.5 per cent on the first two tests and one of 32.1 per cent on the last three. In this case, the reduction is 42.2 per cent. The inconsistency in the scores on the last three tests is not surprising, since the scores approach chance, and this factor would tend to reduce consistent performance. Thus, for operated rats there is a greater reduction in score, indicating that for them the last three tests are relatively more difficult than the first two. If we compare the effect of cortical lesions on the first two tests, we find that the preoperative score is reduced 36.1 per cent after cortical injury. The effect of cortical lesions on the last three tests is to reduce the preoperative score 46.8 per cent. Thus the latter tests of the day are more delicate measures of the effect of cortical injury.

These results indicate that repeated testing not only reduces the scores but increases the relative complexity of the problem. This kind of increase in the complexity of a problem is in contrast

TABLE 4

Record of rats before and after brain injury

RAT	SCORES BEFORE OPERATION					SCORES AFTER OPERATION				
	First test	Second test	Third test	Fourth test	Fifth test	First test	Second test	Third test	Fourth test	Fifth test
7	19	17	17	16	18	15	17	16	14	17
9	19	18	17	18	13	17	18	14	15	14
11	19	15	15	14	14	14	13	14	10	13
22	19	19	19	12	16	13	10	7	12	11
26	20	20	19	20	17	17	16	14	14	13
27	20	18	14	16	15	16	14	10	15	12
29	17	19	14	17	15	16	18	11	19	14
32	19	18	15	15	17	14	16	12	14	13
33	19	19	16	17	15	17	16	9	13	15
35	19	20	19	17	17	17	17	10	17	16
38	19	19	15	14	16	17	14	13	14	11
Average...	19.0	18.4	16.4	16.0	15.7	15.7	15.4	11.8	14.3	13.5
Per cent correct..	90.0	83.6	63.6	60.0	57.3	57.3	53.6	18.2	42.7	35.5
Combined score, per cent correct.....	86.8		60.3			55.5		32.1		
Reduction in score, per cent.	30.5					42.2				

with the results obtained by Lashley and Wiley (1933) in their investigation of learning. They found that as the number of junctions in a maze were increased, the trials and errors required to learn increased for both normal and operated rats, but the relative increase in trials and errors was the same for normal and operated. Their results indicated that increasing the number of elements in a learning problem increased its quantitative difficulty, but did not affect the qualitative complexity of the problem. Our results indicate that repeating a test increases the qualitative complexity of a problem. This conclusion, of course, assumes that cortical injury reduces the complexity of an animal's behavior. A reduction in sensory or motor capacity due to brain injury cannot explain the reduction in score due to repeated testing, since the first and latter tests of the group require the same sensory and motor equipment.

c. Changes in motivation and attention and their effect on the reduction in score due to repeated testing

It now becomes our problem to determine the cause of the reduction in score after the first two tests. We have evidence which suggests that the problem has increased in complexity; but, thus far, no indication as to the nature of the increase in complexity.

A possible cause for the reduction immediately suggests itself. Since the animal receives food after each test, it might be supposed that a reduction in the hunger drive is responsible for the reduction in performance.

Two factors, however, are inconsistent with this interpretation. In the first place, a reduction in motivation does not explain the apparent increase in the complexity of the problem, unless it is assumed that food more readily reduces the hunger in operated than normal rats. In the second place, a reduction in motivation should be progressive. The results show, however, a marked decrease after the second test and rather consistent performance thereafter. Furthermore, it will be shown that the reduction in score can be caused to appear after the third test.

The factor of attention is a somewhat more likely possibility. Maier (1930) found that when test runs were repeated in a routine problem situation, there was a reduction in score after the first day's test, and that this reduction in score continued rather constant thereafter. He also found that the first four runs of a day resulted in better scores than the last four runs. Whether or not this drop in score occurred after a particular trial was not determined. Maier also demonstrated that any change in the situation resulted in an increase in the score. Thus a vacation was found to give rise to a marked improvement in score.

Although the study of attention employed a problem situation in which the animal was required to repeat its behavior, it is possible that there may be a loss in attention in the present study which required the animal to solve five similar problems in succession. Since the animals were ordinarily not tested on Sundays, our present data may be analyzed to determine the effect of this day of rest. By comparing their scores on the day before with those the day after one day of rest we obtain a comparison of the effect of six days of consecutive work with the effect of one day of rest. Table 5 summarizes these data.

TABLE 5

Effect of vacation on reduction in score (based on 87 cases)

	DAY BEFORE VACATION	DAY AFTER VACATION	AVERAGE OF ALL TEST DAYS
	per cent	*per cent*	*per cent*
Average score on first two tests..........	81.6	77.0	79.9
Average score on last three tests.........	62.5	57.9	59.4
Reduction................................	23.4	24.8	25.6

It will be seen that the vacation period has very little, if any, influence on either the first two tests or the last three tests of the day. For the day before vacation, the reduction in score due to repeated testing is 23.4 per cent, and for the day after vacation it is 24.8 per cent. Both of these values approximate the general reduction in score of 25.6 per cent given in table 1.

Thus the factor involved in repeating tests within a day which causes a reduction in score after the second test does not operate between days. It appears that the repetition of tests as such, does not produce the reduction in score, but rather the repetition introduces another factor which is operative after the second test.

FACTOR OF CONFUSION

To determine the cause of the reduction in score, let us consider the effect that repeated testing may have upon the animal's memory. Tables X, Y, and Z, used in the experiment, are unique and can be differentiated from each other. Suppose on the first test the animal is required to run from X to Y. In this case, X is the starting point and Y the table on which it has a moment previously experienced food. Thus Y is made to stand out in the animal's memory and is distinct from the alternative, Z. On the second test, Y becomes the starting place and either X or Z are food places. Again the experience of food on either table will make it unique. On the third test, the food may be placed on one of two tables so that each has previously been a food place. The animal must now choose between two tables on each of which it has experienced food that day. The tables differ in that the food experience on one table is more recent than

TABLE 6

Data on sets of tests in which a choice between two previous food tables appears after the third test

	TOTAL CORRECT RESPONSES	TOTAL ERRORS	PER CENT CORRECT (SCORE CORRECTED CHANCE)
Test 1	210	27	77.2
Test 2	211	26	78.1
Test 3	206	31	73.8
Test 4	183	54	54.4
Test 5	195	42	64.6

that on the other, and in that one was a starting place in the meantime. It is, therefore, on the third test that the food experience on a particular table has lost its distinctiveness. On the fourth and fifth tests, the same situation is present; the animal must solve the problem on the basis of temporal differences in the food experience.

This analysis holds for all groups of tests except the last group, F (see table 1). In test group F, a choice between two tables, both of which have been food places on the same day, does not appear until the fourth test of the day. If the reduction in score is due to a confusion between two test places (rather than a general effect of repeated testing), the reduction in score for this group of tests should not appear until the fourth test of the day.

To determine this, the data obtained in this group of tests have been treated separately in table 6. From this table, it is apparent that the reduction in score appears on the fourth test. On the first three tests, the scores range from 73.8 to 78.1 per cent, and on the fourth and fifth tests the scores are 54.4 and 64.6 per cent, respectively. The average score on the first three tests is 76.4 per cent, and the average score on the last two tests

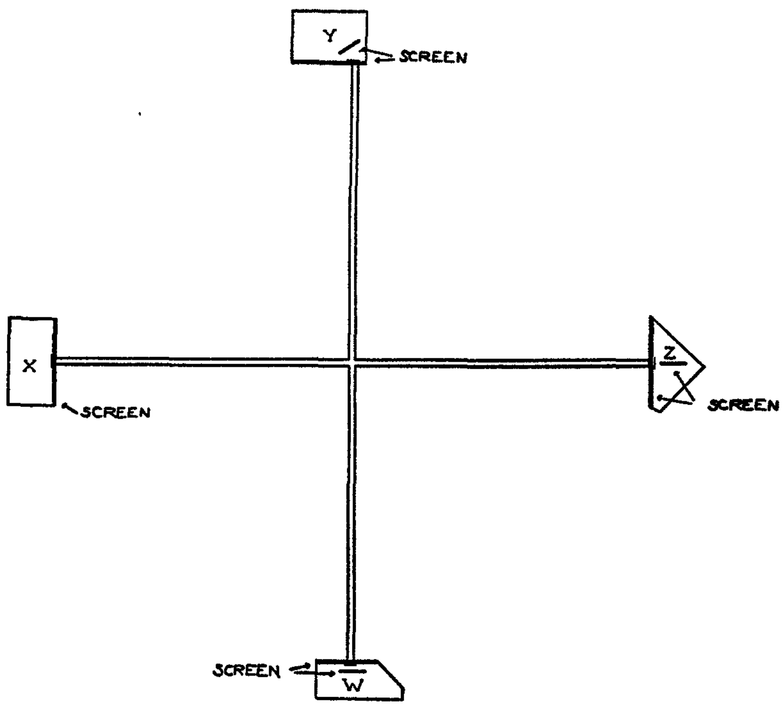

FIG. 2

is 59.5 per cent. The reduction in score for the last part of the test period is 22.1 per cent. This reduction in score is comparable to that obtained in table 2.

To test this possibility further, a new group of 23 rats was given 20 groups of test trials in which the fourth test required a choice between two food tables on both of which the animal had experienced food on that day. In this experiment, four tables were used and arranged as in figure 2. The forward-going path was blocked at the intersection by an upright piece of wood. The

TABLE 7

Test combinations used in four-table problem

TEST GROUP	TEST	STARTING POINT	FOOD PLACE	ALTERNATIVE CHOICE	PATH BLOCKED
A	1	*W*	*X*	*Z*	*Y*
	2	*X*	*Y*	*W*	*Z*
	3	*Y*	*X*	*Z*	*W*
	4	*X*	*W*	*Y*	*Z*
	5	*W*	*Z*	*X*	*Y*
B	1	*Z*	*Y*	*W*	*X*
	2	*Y*	*X*	*Z*	*W*
	3	*X*	*Y*	*W*	*Z*
	4	*Y*	*Z*	*X*	*W*
	5	*Z*	*W*	*Y*	*X*
C	1	*W*	*Z*	*X*	*Y*
	2	*Z*	*Y*	*W*	*X*
	3	*Y*	*Z*	*X*	*W*
	4	*Z*	*W*	*Y*	*X*
	5	*W*	*X*	*Z*	*Y*
D	1	*X*	*W*	*Y*	*Z*
	2	*W*	*Z*	*X*	*Y*
	3	*Z*	*W*	*Y*	*X*
	4	*W*	*X*	*Z*	*Y*
	5	*X*	*Y*	*W*	*Z*
E	1	*Y*	*X*	*Z*	*W*
	2	*X*	*W*	*Y*	*Z*
	3	*W*	*X*	*Z*	*Y*
	4	*X*	*Y*	*W*	*Z*
	5	*Y*	*Z*	*X*	*W*
F	1	*Z*	*Y*	*W*	*X*
	2	*Y*	*X*	*Z*	*W*
	3	*X*	*Y*	*W*	*Z*
	4	*Y*	*Z*	*X*	*W*
	5	*Z*	*W*	*Y*	*X*

procedure was the same as in the three-table experiment. The animal experienced food at the food place by being placed there and was then started from one of the other tables. The test combinations used are given in table 7.

TABLE 8

Scores made by rats on four-table problem

RAT	NUMBER OF CORRECT RESPONSES IN TWENTY GROUPS OF DAILY TESTS				
	First test	Second test	Third test	Fourth test	Fifth test
40	20	18	19	16	17
41	19	20	20	18	18
42	18	20	19	18	16
43	19	18	19	17	15
44	20	20	19	20	19
45	18	18	18	17	14
46	18	18	17	17	14
47	14	15	17	17	14
48	18	15	19	15	14
49	18	18	18	19	17
50	19	18	18	16	16
51	18	14	18	15	16
52	19	16	19	17	18
53	19	19	18	18	17
54	18	20	17	16	13
55	20	16	17	17	20
57	19	19	17	17	18
58	20	20	17	17	19
59	18	17	18	16	16
60	16	20	18	15	18
61	18	17	19	17	18
62	20	19	18	16	17
63	19	18	17	16	16
Average...........	18.48	17.96	18.13	16.83	16.52
P.E. av...........	.188	.244	.136	.170	.257
S.D..............	1.34	1.74	.97	1.21	1.83
Per cent correct...	84.8	79.6	81.3	68.3	65.2
Combined score...	81.9			66.8	
Reduction, per cent............				18.4	

It will be seen that in each case, the fourth and fifth tests require a choice between a table on which the animal has just received food and a table on which it received food on the second or third test. If the confusion arises because of inability to distinguish the last of the two feeding places, the reduction in score should appear on the fourth and fifth tests.

Table 8 shows this to be the case. For the first three tests, the average scores are 84.8, 79.6, and 81.3 per cent respectively. The average for the three tests is 81.9 per cent. For the last two tests, the scores are 68.3 and 65.2 per cent. The average for the last two tests is 66.8 per cent. The reduction in score for the last two tests is 18.4 per cent.

DISCUSSION

The evidence presented in this paper shows that the rat has difficulty in choosing between the last position of the food and its previous positions. As long as there is a choice between a food and a no-food table, the accuracy is high; but as soon as both alternatives have been food tables, there is difficulty in choosing the one on which food was last experienced. This occurs, despite the fact that the rat has experienced the removal of food. It appears therefore that the experience of the absence of food on a particular table does not neutralize the effect of a previous experience of food on this table.

Since the tables are not perceptually present at the time a choice is required of the rat, we are dealing with a form of confusion in memory. It is our task to find a theory which will explain the nature of this confusion. Confusion is a term which denotes a kind of conscious state, but can hardly be regarded as an explanation of psychological phenomena.

The experiments of von Restorff (1933) are suggestive of the mechanisms which make for such confusion. She has demonstrated that material which differs in kind from other material has a recall value far greater than homogeneous material. Thus a pair of nonsense syllables imbedded in a series of pairs of numbers has recall value superior to the pairs of numbers because of the uniqueness of the syllables in such a situation. When a pair of nonsense syllables is learned with several pairs of numbers, the nonsense syllables are best recalled. Likewise homogeneous material loses in recall value the greater the homogeneity. Retroactive inhibition is explained by postulating that a second period of learning reduces the uniqueness of the material previously learned. For example, a pair of nonsense syllables memorized with many pairs of numbers has a certain potential recall value. If, however, a new series of pairs of syllables is learned before the recall test, then the recall value of the nonsense syllables is reduced, whereas the recall value of the numbers is affected little if at all.

Koffka (1935) interprets these facts as evidence for the theory that memory traces may form aggregates. Similar memory traces fuse and consequently lose their identity. Accurate reproduction is dependent upon the relatively complete isolation of memory traces.

In the present experiment, the animal is required to combine separate past experiences. To reach the food, the various experiences must retain their identity in the animal's memory. Since the tables are unique, this is successfully done.

On the first test of a day, one table becomes the starting place and one of the other two tables is unique in that food has been eaten on it. Because of this food experience on one of the tables, the memory traces for the tables retain their identity. On the second test, which immediately follows, the same situation is present. The old food table has become the starting table and cannot be chosen, and a choice between the new food table and a neutral table remains. Repeated testing, however, eventually requires a choice between two tables, both of which have been associated with food at different times. The memory traces of the tables no longer differ in the place of the food experience, but only in the time of the food experience. This time difference is not sufficiently great to overcome the trace effect of the food experience and a reduction in the uniqueness of the memory traces of the tables results. As a consequence, the traces give rise to aggregates, and the alternative choices lose in identity. It is because of the formation of such aggregates that repeated testing shows inferior performance.

SUMMARY

It is the purpose of this investigation to determine whether or not the ability to keep experiences separate and unique plays a part when an animal is required to combine certain isolated past experiences in such a manner as to achieve a goal.

The simple three-table reasoning test previously utilized by Maier was used, but instead of giving one test per day, five different test combinations were given in succession. If keeping separate experiences unique is a factor in problem-solving, such repetition of tests should result in a reduction in performance.

The results show that on the first two tests of the day, the scores were approximately the same, and on the last three tests of the day the scores also approximated each other, but were decidedly lower than those made on the first two tests. The average score for the first two tests was 79.9 per cent correct, and that for the last three was 59.4 per cent, a reduction of 25.6 per cent. For rats with cortical injuries, this reduction was 42.2 per cent, indicating that the giving of several tests in succession increases the qualitative complexity of a problem.

Since the reduction in score occurred only after the second test of the day, it became necessary to analyze the cause of this lowered score. The evidence shows that a specific kind of confusion enters the situation after the second test. By altering the situation, the reduction in score could be caused to fall after the third test.

The Gestalt theory of memory traces is utilized to explain the nature of this confusion. According to this theory, similar memory traces tend to form aggregates. Repeated testing in our experiment may reduce the uniqueness of the memories of the tables in only one way. This occurs when a choice between two tables, both of which have been food tables at different times, is presented to the rat. Since on the first tests of the day the choice is between a food and a no-food table, the memory traces at this time are more unique.

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