

THE EFFECT OF PSYCHO-PHYSICAL ATTITUDES ON MEMORY

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I. INTRODUCTION

THE investigation to be described was conducted in the Harvard Psychological Laboratory during a period of two years. Nine subjects took part in the experiments during the greater part of the first year and nine during the greater part of the second year. Five were common to both periods, and all were members of the laboratory.

This work is not quite the same as the orthodox memory experiment, but was suggested by the following facts well known to all psychologists. It is found that, due to some sudden shock, whether emotional or physical, one or both of the following may happen.

1. The most recent events just preceding the shock may be lost, *or*
2. Those events immediately *after* the shock may be lost.

Both of these may occur in any instance or only one. The latter is usually the more common and even where both occur this loss is more extensive.

Time was when psychologists considered the abnormal individual as something totally different from the normal type, but to-day matters have changed, and there is a growing belief and conviction that there are no strong demarcation lines, and that, in general, the abnormal case only shows very exaggerated conditions of what is found in the normal individual. On account of the absence or comparative absence of this exaggeration we say that the normal person is better balanced. Sanity and insanity are then relative terms. The whole question is one of proportion, which is decided by fitness to meet environment.

More particularly, then, an attempt will here be made to see how far the memory of the normal individual is influenced by shocks; to determine the influence of pleasant

and unpleasant feelings on memory; to see how different kinds of ideas crowd one another out; to find out some of the factors which have an influence on memory after impressions have been received, and to discover if possible the significance of this after period. Further, if it be found that to all appearances some impressions are forgotten on account of some particular filling of the after-period, can some or all of them be recovered?

This outlines the general field. Needless to remark, no complete answer is given, but it may open up new ground in a somewhat neglected field.

Some years ago the aim of the experimental psychologist was to find out general laws, and little stress was given to individual differences, but now there is a growing tendency to see in these seemingly small differences powerful factors in deciding the make-up of the individual. In what follows there are some things which are common to all, and some strictly individual, and of these individual differences some are and some are not explained.

II. METHOD AND MATERIAL

For the most part words were the material used. They were arranged in lists of twenty. In some cases the words forming a list were associated with one another and in other cases they were detached or isolated. Some lists were made up of pleasant or unpleasant words respectively, and in some experiments colors were used. The method consisted of a combination of reproduction and recognition, except in the case of colors, where recognition alone was employed.

These lists of twenty words were read to the subject in an even tone and with great regularity. (Timed to the tick of a stop-watch.) This required practice and hence for a considerable period, at first, no results were counted. The subject was instructed to reproduce the words remembered at a given signal, and the time was taken with a stop-watch from the giving of the signal until the subject uttered the first word. As mentioned above, the filling of this period after the reading of the words and the giving of the signal

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was varied as will be described under the head of each experiment. The receptive attitude of the subject was also varied in the different experiments — sometimes it was passive, and at other times he was told to remember in an active way. The conditions of the experiment also varied the receptive attitude in an objective way.

III. EXPERIMENTAL

The first study to be taken up is the influence of the feelings of pleasantness and unpleasantness on memory. This is not altogether new, but it has an important bearing on other experiments, and the subject was approached in a somewhat different way, not altogether agreeing with the work of some other experimenters. This problem was investigated in three different ways.

1. Lists of words used to test memory were either pleasant or unpleasant.

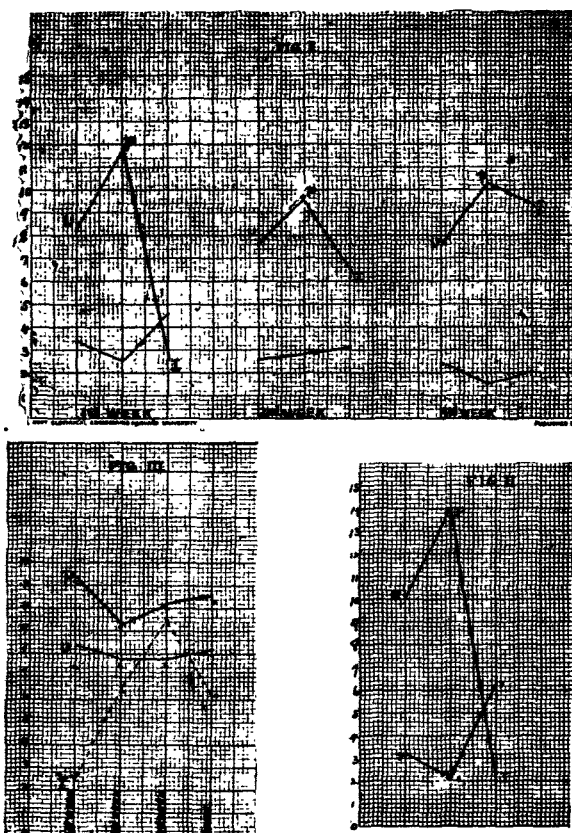
2. Neutral lists with the after-period filled in by something pleasant or unpleasant.

3. Recognition of colors.

- (1) Lists of twenty words each were read to the subjects, and three kinds or classes of lists were used. In one, the words composing the list were pleasant, optimistic, cheerful; in a second, unpleasant, pessimistic, cruel; while in the third the words were as devoid of feeling tone as possible. In none of the lists were the words purposely associated. The experiment in this connection covered a period of three weeks, and eleven subjects took part; they were instructed not to use any artificial means of remembering the words or to form any associations, but simply to take the words as they came, let them drop in and see how many remained.

Fig. I shows the results in graphic form. The ordinate shows the number of words remembered out of twenty. U=unpleasant list, P=pleasant list, I=indifferent list.

The lower lines represent the time from the giving of the signal until the subject uttered the first word. Each point—U, P, I—represents the average number of words remembered by eleven subjects. Curves for each of the three weeks are given. Fig. II is an individual record



chosen more or less at random. Fig. III gives the average results grouped.

The obvious conclusion is that the pleasant words are remembered better than the unpleasant or indifferent. The last week is an apparent exception because the supposed indifferent list was not indifferent for over half the subjects. It is also worthy of note that the unpleasant words are remembered better than the indifferent. It will also be seen that the time is shorter in cases where there are more words remembered, that is, the time is shortest in the case of the pleasant words and longest in the case of the indifferent. This is in agreement with the results of Bigham, *viz.*, that

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the quicker the memory, the better it is, or the better it is, the quicker it is. One limitation must be made to that statement. We must always distinguish between immediate and retentive memory. Immediate memory is better, the quicker it is, but this is by no means necessarily true of retentive memory.

In only one subject were the unpleasant words remembered better than the pleasant ones, and as this is not regarded as an exception it will be discussed later.

The introspection is in substantial agreement with the objective results.

Introspection on pleasant lists. "Words isolated and disconnected and yet they were easy to remember."

"List seemed on the bright side of life and easy to remember."

"List seemed optimistic and easy to remember."

"Considerable emotion was an aid in the case of four or five words. No negative influence of emotion. Words did not inhibit one another as in the case of the unpleasant list."

"Words had an emotional tinge and easy to remember."

"No emotion."

"Some emotion connected with this list, especially the word 'hero,' which hauled other words along with it. Easier to remember than the last list (unpleasant)."

"More emotion connected with this list than with the other, and remembered more easily."

"Ill-defined feeling of satisfaction. This was a decided aid."

Introspection on unpleasant lists. "The words which are remembered stand out prominently and inhibit others."

"Decided emotional coloring."

"Vivid emotion, words seemed to crowd one another out."

"Not conscious of any emotion."

"No emotion. Words remembered stood out in relief and inhibited others. This was very noticeable."

"No emotion. Words remembered stood out clearer than the other words, so clear that they seemed to inhibit other words."

"Some emotion."

"Words remembered stood out plainly and seemed to inhibit others. The word poverty is an example."

It will be noted that many of the subjects, and those the most observant, speak of the inhibitory effect of the unpleasant words. There may be three reasons for this. First, it may be due to a strife between the expressions aroused by the unpleasant words and a more or less pleasurable attitude in the subjects themselves previous to hearing the list. Secondly, it may be due to a strife between the expressions aroused by the words individually. Expressions of unpleasantness are not so well unified as pleasant ones; the emotions connected with them and the accompanying expressions or instincts are more diverse than in the case of pleasant emotions. The latter is the more likely. Thirdly, unconscious suppression of the unpleasant.

(2) In the experiment described the lists were intrinsically pleasant, unpleasant or indifferent. In the following, the lists are all as indifferent as possible, and the words forming such lists were not associated in any obvious way. The receiving mood of the subjects was as far as possible the same. The influence of pleasantness or unpleasantness was introduced after the lists were read to the subjects. After one list something pleasant, optimistic and cheerful was read to the subject; after another something unpleasant and depressing was read.

The results here are not so evident, due to the fact that the reading itself was a distraction and that the associations thus involuntarily introduced would be as various as the different subjects. The work on this aspect of the question covered a period of three weeks with eleven subjects. The results may be summed up as follows:

	AVERAGE % OF WORDS REMEMBERED
When list was followed by pleasant ideas	21
When list was followed by unpleasant ideas	15

There is a difference of six per cent in favor of the pleasant words, which is in accordance with the results of the preceding experiment.

An individual example of how one unpleasant idea may

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inhibit others and yet remain itself is well evidenced in the case of one subject specially well trained and very acute in the way of introspection. A list which was apparently neutral for all the other subjects contained the word "fagot." This immediately brought up vivid recollections of tortures contained in Lecky's *History of European Rationalism*. In this instance every word with the exception of "fagot" was obliterated. Evidently, the feeling and emotional tone connected with the word in question was very strong, and possessing a strong attitude, inhibited all others with different expressions or attitudes. Put in another way it would be that the complex — for no idea is alone — to which "fagot" belonged was stronger than the other complexes, strength being defined in terms of emotion and feeling, which accompany certain motor expressions. However, this is anticipating.

Introspection. "Had list excellently in mind before hearing about the torture. Its influence is destructive."

"Tortures seemed to scare one from the words."

"Reading about tortures is far more destructive than other reading."

"Felt that words remained better by the pleasant reading."

"Mind an absolute blank after the unpleasant reading, and many words never came back."

"Mind a blank after reading the unpleasant story."

The evidence so far seems to show that unpleasant ideas have a tendency to be suppressed and have a suppressing influence on other ideas with which they are connected intimately or even more remotely.

(3) The third method was the recognition of colors. Here a series of fifteen colors was shown to the subject on a uniform gray background, and he was asked to pass judgment according to the following scale:

1. Very pleasant.
2. Moderately pleasant.
3. Just pleasant.
4. Indifferent.
5. Just unpleasant.

6. Moderately unpleasant.

7. Very unpleasant.

After the judgment of the series was completed, two or three alterations were made in it by changing as many of the colors. The series thus changed was again shown to the subject in a different order and judgments again asked for. The subject was also asked after the exposure of each color if that color was in the preceding series.

In all, two hundred and forty-two tests were made, and the results can be summed up as follows:

Averaged number of pleasant colors remembered	63.4%
Average number of unpleasant colors remembered	47.2%
Average number of indifferent colors remembered ..	27.3%

The results would be much more marked but for the fact that one subject had the heartiest detestation for the whole work with colors, and reported every color unpleasant with but few exceptions. To some extent the same holds true in the case of two other subjects who came in the afternoon and were very often fatigued by their work of the morning. These exceptions could be explained on the theory that the tone of the existing complex is stronger than that of the incoming impressions and the same mantle is thrown over them.

It may seem strange that the unpleasant impressions are remembered better than the indifferent. A reason might be given that both the pleasant and unpleasant impressions arouse a definite attitude on the part of the organism, and are biologically important, whereas the indifferent impressions can be ignored. There are two sides to this attitude, so that it can be called a psychophysical attitude. On the physical side there is the arousal of certain instincts or impulses, or the combinations of these instincts or impulses into complexes. On the psychical side there are the emotions and complexes of emotions corresponding to the instincts and impulses. Added to this again are the feelings of pleasantness or unpleasantness. It must not be understood that the instinct and emotion are different or even running parallel, but they are one and the same fact looked at from a different point of view. It may also be said that

if any instinct is stopped or arrested in its expression the feeling of unpleasantness is apt to be aroused. Motor activity is curtailed. This may come about by the conflict of different instincts. Physiologically the matter can be resolved into the compounding of reflexes.

It might be well to say what is meant by attitude. As used here it means instinctive actions or impulses or the combination of such with their accompanying emotions. To all this is added feeling tone of pleasantness or unpleasantness in various degrees, and also the whole list of the so-called organic attitudes, which by their varied combination form a background and coloring for the whole mental life. To cover all this the term "psycho-physical attitude" is used.

The pleasant impressions are remembered better because the reactions which they arouse are in harmony with the welfare of the organism; that is, the attitude which is aroused has a tendency to be continued, and in many cases this may be only an incipient response. Unpleasant impressions are rejected for the opposite reason; that is, they arouse attitudes which do not have a tendency to be continued, except in abnormal cases. Looked at from the point of instinct, one can say that instincts which have a pleasant feeling tone have a tendency to propagate themselves, and the opposite is true of instincts which are accompanied by unpleasant feelings. Indifferent impressions are not remembered well because there is practically no attitude aroused either towards or away from. •

However, there is another side to all this. In some cases unpleasant impressions may be remembered better. This may be due to the fact that the existing complex has an unpleasant feeling tone which is so strong that it decides which impressions shall be selected from those incoming. This is what happens in abnormal cases, and one can conceive that there is a pleasure in so doing. In short, the tone of the existing attitude or complex (for those who like that word better) is a deciding factor in what shall be remembered. Now this tone is to a large extent influenced by the various compounds of instincts which are aroused, that is, by compounds of reflexes, so that in the final analysis it is a matter of reaction whether we speak of attitude or instinct or complexes, or of emotions or of reflexes.

IV

As already stated, the period after the impressions are made is an important one. Some of the experiments to follow were performed with reference to this problem. Words were used as material and read to the subject as in the preceding experiments. After the list was read to the subject, one of several distractions was introduced before the signal was given for the reproduction of the words remembered.

The following table is submitted:

TABLE A

	a	b	c	d	e	f	g	h	i	j		MEAN	M. V.
8.	20.	25	20	35	25	35	25	30	45	35	.....	29.5	6.5
9.	20	25	15	20	15	30	10	35	60	30	.....	26.0	9.8
10.	15	10	..	0	25	25	15	20	25	35	.....	18.8	7.9
11.	20	15	..	20	30	25	25	..	15	40	.....	23.7	5.7
12.	15	20	26	15	25	25	10	0	..	..	.....	17.0	4.3
13.	0	..	..	..	15	30	15	25	..	30	.....	19.1	5.1

A word of explanation concerning the table. The letters at the head represent the different subjects, and the numbers under each, the percentage of words remembered out of a list of twenty. The numerals to the extreme left refer to the various tests in order to be able to identify them throughout the investigation. The mean and the M. V. are self-explanatory. Except in the case of the shot, the interval after each list was one minute, filled as follows:

8. Passivity.
9. Attention directed towards recalling the words.
10. Disagreeable odor.
11. Sudden ringing of hidden bell.
12. Pistol shot.
13. Dizziness.

Ten subjects took part in this test. During the reading of the lists they were instructed to be passive and just sufficiently awake to take each individual word. Words making up the lists were not associated with one another.

It is at first noticeable that the ordinary sense stimuli have little effect, due to the fact that they do not arouse any strong attitude. The factor which seems to have played

the greatest part in this subsequent interval was some kind of concentrated mental activity, such as arithmetical calculation, etc. In nearly every case, the list of words was entirely forgotten. *That they disappear for good is another question to be considered later.* In many cases the pistol shot had an almost equal effect with the mental work, and for the same reason. It required an adjustment out of the ordinary, and hence the attitude was strong at first. Associations, etc., also play an important part in the feeling tone. However, it is not so uniform in its effects, and in many cases the effect grew less and less. Odors seemed to have little influence on most subjects, and those who were affected attributed it to some association or more commonly to the fact that there was something held near the face. Without this remark some of the numbers in the table would be misleading.

The most favorable condition seems to have been passivity, where the subject was instructed to be passive and let himself drift along. In plain figures attention does not seem to have been so good as passivity, but the difference is too small to be of great importance. It may be that the very fact of trying to recall the list during the one minute has something of the same effect as other mental work, and thus a new psycho-physical attitude is introduced. The fact that the passive state is a little better than attention seems to lend color to the view of some that a certain period after impressions are received is necessary for organization and assimilation. It may be that memory is better in one case than another because there are no conflicting attitudes. The longer the attitude aroused by the impression continues, the better the chance of memory for that impression, and of course the opposite holds true. If the attitude aroused at first is curtailed by the intervention of another or of others, then the first impression loses its hold, so to speak. This may also apply to abnormal cases.

The introspection is as follows:

“Effort of attention did not seem much of an aid.”

“Odor seemed to interfere.”

“Bell did not interfere.”

- "Not much effect from pistol shot."
 "Dizziness seemed to drive some words away."
 "Shot erased some words, nervous tonus over the whole body."
 "Effort of attention seemed to retard memory."
 "Bell did not bother much."
 "Bell a little startling at first but soon lost its effect."
 "Do not feel that attention is any aid."
 "Odor attracted attention."
 "Odor interfered with memory."
 "I cannot see that attention was successful."
 "Shot was complete interruption — felt as if my mental powers were out of commission."
 "Bell was not much of a disturbance."
 "Effect of attention was beneficial."
 "Do not think that attention was beneficial."
- In the experiment tabulated in Table A the distraction or shock was applied after the list was read, but in the following it was given about the middle of the list.

TABLE B

	a	b	c	d	e	f	g	h	MEAN	M. V.
15.	20	25	20	30	30	20	25	35	25.6	4.5
16.	10	20	10	25	40	20	25	10	20.0	7.5
17.	5	5	0	20	15	5	15	5	8.7	5.9
18.	5	20	10	..	20	..	5	..	12.0	6.4
19.	15	25	25	..	..	25	25	25	23.3	2.8
20.	15	..	..	20	20	25	15	25	20.0	3.3

This table is arranged on the same principle as Table A, so no further explanations are necessary. The conditions in each case were as follows:

- List 15, Hidden bell rung in the middle of the list.
 List 16, Shot in the middle of the list.
 List 17, Puzzle *after* the list.
 List 18, Exercise after the list.
 List 19, Odor in the middle of the list.
 List 20, Rotation during reading of the list.

In this test as in the preceding one the subjects were

passive. A few facts in connection with the above table and Table A are to be noted.

1. The shot, although not so destructive coming in the middle of the list as when coming after it, has more effect than the other distraction. Objectively from the table it is on a par with rotation, but in this latter instance there was in some cases a difficulty in hearing the words.

Coming in the middle of impressions the shot seemed to have different effects on different individuals, which are not shown in tables. With some, the words after the shot are lost, that is, in the latter part of the list, while with others it is the words in the earlier part of the list, or before the shot, that disappear. On the whole, however, it seems that not so many are lost as when the shot comes at the end; that is, it has a retrograde effect. This can be seen by comparing Table A with Table B. To some extent, it is true, in cases where the words after the shot have disappeared, that those before it are all the more firmly fixed, or, as one subject put it, they are "frozen stiff." In other instances, when the words before the shot were lost those coming after it were reinforced.

2. It will also be noticed that the solving of a puzzle at the end of a list is more destructive in its effects than the shot was in Table A. An average of 10 words was remembered after the puzzle and 16.6 after the shot.

3. It may be added that the sudden disturbances seem in many cases to drive the subject to the list, and in the majority the words which are retained are those which come after the distraction. On the whole it seems pretty evident that distractions coming in the middle of a list are not so destructive as if coming at the end. The greatest effect, then, is retroactive.

The introspection is as follows:

"Lost the words before the bell."

"Shot brings me back to the words."

"Bell disturbed what came later."

"Shot brought me back to the list."

"Shot was a great disturbance. Seemed to be an exhilaration."

"Bell disturbed what came after it."

"Lost some words immediately after the bell. Felt as if I came back to the list with a feeling that I had been away from it."

"Bell cut away the first part of the list."

"Effect seems to be on words preceding the shot."

"Bell broke up the first few words."

"No words remembered after the pistol shot."

V

So far the lists used were made up of detached or isolated words, that is, they were not associated with one another in any evident way. In the following experiment the list in each instance was made up of associated words, in some cases concrete, and in some cases abstract. The following is the table of results:

TABLE C

	a	b	c	f	h	i	MEAN	M. V.
21.	30	25	25	45	15	55	32.5	11.6
22.	35	25	35	30	25	55	34.1	7.5
23.	30	35	30	30	30	25	30.0	1.6
24.	20	20	25	30	25	30	25.0	3.3
25.	20	15	35	35	5	50	26.6	11.6
26.	10	20	15	30	0	15	18.0	7.6

The table below will show how the interval after the list was filled in each case, and also the character of the list.

21. Concrete associated list followed by one minute passivity.

22. Abstract associated list followed by one minute passivity.

23. Concrete associated list followed by one minute attention directed to recalling the words and holding them till the signal was given.

24. Abstract associated list with the same conditions as 23.

25. Concrete associated list followed by pistol shot.

26. Abstract associated list followed by pistol shot.

The most noticeable thing here is the effect of the shot on the concrete and abstract lists. Only in the case of one

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subject are more abstract words remembered after the shot, and the subject was an inveterate Hegelian. In the instances of lists 25 and 26, where the list was followed by the pistol shot, an attempt was made to see if any words which had been lost by the effect of the shot could be recovered. This was successful on four subjects and the means employed as follows:

A metronome was set going, and the subject was instructed to give a word for each beat of the metronome and not to choose words, but give any that came up irrespective of whether they belonged to the list or not. This process was successful in the case of concrete words, and only very partially successful in the case of abstract words; in fact, no success at all. The facts may be tabulated as below. The numbers represent the per cent of the lost words which were recovered.

SUBJECT	ASSOCIATED	ASSOCIATED
	CONCRETE	ABSTRACT
a	18.7	16.6
b	17.6	0.0
c	15.3	0.0
f	<u>23.0</u>	<u>0.0</u>
Mean	14.9	3.3

This experiment of trying to recover lost words was tried on five subjects only, and the average computed on that basis. It is readily seen that the concrete associated words have the advantage, not only in ease of recovery, but also the fact that the shot was not so destructive on them in the first instance. A tentative explanation in keeping with the rest of the experiment might be, that the concrete words have more marked attitudes, that more instinctive and impulsive reactions are connected with them, and more feeling tone. This also agrees with Ribot's Law of Regression.

In Table A we saw the result of distractions coming after lists of words made up of detached words. In the experiment now to be described the effect of those distractions will be studied when coming *after* lists of associated words.

TABLE D

	a	b	c	d	f	g	h	i		MEAN	M.V.
27.	50	15	25	35	45	35	20	30	.....	31.8	9.2
28.	25	30	30	45	45	30	35	35	.....	34.3	5.6
29.	60	30	45	40	50	50	..	40	.....	45.0	7.1
30.	20	10	..	15	50	20	5	30	.....	21.4	10.4
31.	15	35	45	45	40	30	25	55	.....	36.2	10.0
32.	..	40	20	..	45	40	..	25	.....	34.0	9.2
33.	0	25	25	25	20	0	10	45	.....	78.7	11.5
34.	0	5	0	5	10	0	0	10	.....	3.7	3.7

The following schedule will show how the periods after the various lists were filled.

List. Filling of after period.

- 27. Immediate reproduction. No after period.
- 28. Passivity for one minute.
- 29. Attention for one minute.
- 30. Shot.
- 31. Bell.
- 32. Odor.
- 33. Followed by one minute arithmetical work.
- 34. Followed by one minute arithmetical work.

This series was made up of eight lists, the first seven of which were composed of associated words, and the last one of detached words. The same conditions, as to subject and experimenter, hold as in the previous experiments. The purpose of the first six lists was to test the influence of distractions on associated material, and in the case of the last two to see if the words which were lost could be recovered, and to ascertain the difference in this respect between associated and detached words. Eight subjects took part in the experiment. The following results may be noted.

(1) Of the sensory disturbances the shot is as before the greatest, but not so great as the mental work represented by the arithmetical calculation, as is shown by comparing list 33 with list 30.

(2) Spending the minute after the list in giving some attention towards getting back as many words as possible is more beneficial than passivity. This is directly opposed

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to the results in the case of detached words as recorded in Table B. Reproduction of associated words is benefited by the direction of attention on their recall.

(3) The bell and the odor made very little difference, being practically on a par with the passive period.

(4) One of the most important things is the number of words recovered in lists 33 and 34. The former was made up of associated words, and the latter of detached words. These results can be tabulated as below.

SUBJECT	PER CENT OF WORDS RECOVERED	
	ASSOC. LIST	DETACHED LIST
a	35	0
b	6.6	0
d	13.3	0
f	12.3	0
g	35.0	0
h	5.5	0
i	9.0	0
Mean	15.2	0

This was tried on seven subjects, and a metronome was used as before, but the detail of the method was somewhat different. In the former experiment a stenographer took down the words as spoken by the subject in rhythm to the metronome, but in order to do this the metronome had to run at a comparatively slow speed, and it was found by trial that a slow speed was not so effective in bringing back lost words. Then, too, the articulation of the subjects speaking rapidly made it hard for any one to get all the words, and hence many were inevitably lost. In place of this the subject was instructed to write down words to the beat of the metronome, and not to make any selection in so doing. This was found to be a better method than that of selection. In all cases the subject first gave all the words remembered, before beginning the metronome test.

The fact that no words were recovered from the detached list is quite conclusive as the figures 15.2 to 0 show. Not even a chance word was recovered, neither in this experiment nor in the ones to follow, so that the recall of the associated words cannot be attributed to mere chance, and, in any case, the word "chance" should not be in the psychologist's

vocabulary any more than in the physicist's. One might explain it on the grounds that the associated material is grouped around one central attitude, or to look at it from another point of view it forms part of one complex so that when some members of the complex come up there is a tendency for the others to do likewise. They are already part of the mental equipment while the detached material is not, in fact organization might be defined as the grouping of material into complexes or becoming attached to some common or predominate attitude. The detached words are not remembered so well, not because they do not arouse attitudes, but because the attitudes which they do arouse are in many cases opposed, so that there is sort of a mutual inhibition. In a word, the associated material forms a complex bound together by a psychophysical attitude. This same principle applies to the question of pleasantness and unpleasantness.

The experiment next to be considered follows naturally from the preceding ones. In Table E (1) will be given the percentage of words reproduced immediately after the distraction and in Table E (2) the number of words recovered by the metronome method.

TABLE E (1)

	a	b	c	d	e	f	g	h	i		MEAN	M. V.
39.	15	25	20	10	15	25	5	0	50	...	18.3	10.3
40.	30	25	25	35	60	50	20	60	85	...	43.3	18.1
41.	0	5	15	15	0	5	15	0	15	...	7.7	6.4
42.	30	15	55	30	50	60	35	35	30	....	37.7	11.4

TABLE E (2)

	a	b	c	d	e	f	g	h	i		MEAN	M. V.
39.	0	0	0	0	0	6.6	0	0	0	...	0.73	1.3
40.	14.2	13.3	0	7.4	0	0	6.2	0	0	...	4.6	5.0
41.	0	0	0	0	0	0		0	0		0.0	0.0
42.	28.5	35.2	9.9	.	0	62.5	61.5	15.3	7.1	...	27.5	17.2

It will be seen from the tables that four lists were read. The first three of these were made up of detached words, and the last one of associated words. In all cases the attitude of the subjects was the same as in the former experiments, and the tables are on the same plan.

After list 39 the subject was told to remain passive for two minutes and then asked to translate some German. This lasted for one minute, and then the subject was asked for as many words as were remembered. The next thing was the metronome test, which gave a result of .73 or practically nil.

In list 40 the subject was told to remember the words, and the list was read four times. Then followed the German translating, and next the reproduction of words remembered, and finally the metronome test. Only a comparatively few words were recovered by the metronome method.

In list 41 there was no passive period, and the subject was given the German to translate as soon as the list was read. Here fewer words were remembered, and none were recovered by the metronome. It is interesting to compare this list with list 39, where there was a passive period after the reading of the list. In the former cases more words were remembered, that is, the distraction had less effect. It may be explained on the theory that the passive period after the list allows time for the arousal of certain attitudes, and thus helps to fix the words. The case of the learned list and the associated one can be explained on the same basis.

The last list in this series was made up of associated words, and was immediately followed by German translation, then the subject was asked for words remembered, and then the metronome test, which was quite successful, as in previous cases.

In addition to the above observation a few more general facts may be mentioned.

(1) In the case of detached impressions memory is better when there is a passive period after the reception of the impressions. This is in agreement with the previous experiments.

(2) In the case of the learned list more words are immediately remembered, but fewer are recovered.

(3) The number of words recovered by the metronome test is considerable, and bears out previous results in connection with associated material.

The influence of the passive period after impressions

was to some extent noticed in the last experiment and in some preceding. In the following test it is the aim to find out the influence of such a period on both detached and associated material so that they can be more exactly compared in that respect. In addition, the filling of the period after the reading of the list will be looked at from the point of view of attention. To do this the subject was to spend one minute trying to recall as many words as possible and to hold those already in mind.

The following is the table.

TABLE F

	a	b	c	d	e	f	g	h	j	k	MEAN	M. V.
47.	17.5	25	42.5	25	27.5	30	35	25	25	27.5	....28.0	4.7
48.	20	7.5	32.5	22.5	25	30	25	30	22.5	37.5	... 25.2	5.7
49.	37.5	40.0	35	40	35	45	37.5	30	27.5	42.5	.....37.0	4.1
50.	47.5	40	32.5	45	57.5	55	47.5	32.5	32.5	50	....44.0	7.7

The percentage of words credited to each subject is the average of two lists under each condition. The following facts may be noted.

(1) That in agreement with preceding work a passive period after detached impressions is superior to one of effort in trying to recall those impressions.

(2) That the opposite is true in the case of associated material.

(3) That the two foregoing facts are significant in relation to the recovery of words with the metronome, namely, that no words (one solitary instance excepted) were recovered in the detached lists, but only from lists which were made up of associated material.

In view of this, it may be said that a certain period is necessary following a series of impressions in order that they be the better fixed. This period gives time for initial attitudes to take place, and thus group the impressions into a complex. In the cases of the associated material this is unnecessary, for they are already grouped, and for this same reason less affected by distractions. We know also from pathological cases that the material last acquired is the first to be affected by disease, etc.

The experiment next to be considered has to do with the

effect of motor accompaniments as one of the conditions of memory. The method of procedure was as follows: The list of twenty words was read to the subject, who was instructed to be passive, and then as he recalled the words to make some movement for each word thought of. Sometimes it would be the lip and tongue movement or some movement of the arm for each word. After that the subject was given some mental arithmetic for the period of one minute. In this way, it was thought to find out the different fixating power of the various movements. The work was carried on for a period of two weeks, and the percentages for each week represent the mean of two lists under each condition, making four for two weeks under each condition. Further, during the second week the various conditions were placed in different positions in the series from what they were the first week. For example, during the first week the writing of words in the air came first in order of trial, but in the second week it came last. Ten subjects took part for the first week and eight the second.

TABLE G (1). FIRST WEEK

LIST	CONDITION	MEAN	M. V.
77.	Writing words in the air	20 7	5 1
80.	Passive after reading of list	13 4	5.3
82.	Movements of lips and tongue	12 7	4.7
84.	Arm movements for each word	14 0	6 2

TABLE G (2). SECOND WEEK

LIST	CONDITION	MEAN	M. V.
86.	Arm movements	19 0	5.0
88.	Movements of lips and tongue	16 5	8 5
90.	Passivity	14 5	7 8
92.	Writing words in the air	21 2	0 0

Combined results for the two weeks are as follows:

CONDITION	MEAN
Passivity after list, then arithmetic	13 9
Movements of lips and tongue, then arithmetic	14 6
Arm movements, then arithmetic	16 5
Writing words in air, then arithmetic	20 9

It will be seen that the condition conducive to the best fixation is that of writing in the air, second best is

arm movements, then articulatory movements and passivity, in descending order. There are some individual differences which are due to some unavoidable associations by one or two subjects. As throwing some more light on the results, the introspective judgments of the subjects as to the best method are interesting. These are tabulated as follows:

CONDITION	JUDGMENTS IN FAVOR OF
Writing in the air	10
Articulation	4
Arm movements	2
Passivity	2

Practically this bears out the objective results.

In general the results of this experiment are as follows:

The writing of the words in the air is better because such is an organized attitude while the others are not so customary, and hence detrimental to some extent. Articulation was too marked, that is, more expressive than is usual, hence attracted attention to the movement itself. In addition to this the incipient articulatory movements are combined with writing in the air, so that has a double advantage.

SUMMARY OF EXPERIMENTAL CONCLUSIONS

I. Pleasant impressions are remembered better than unpleasant, and both are remembered better than indifferent ones.

II. Not only are such impressions themselves remembered better, but they seem to exert the same influence on other material. Unpleasant impressions have the opposite effect, that is, they exert a repressing influence on other impressions.

III. Ideas are more affected by other similar mental material than by sensory disturbances, unless these latter arouse strong psycho-physical attitudes, e.g., the pistol shot.

IV. That such distractions, whether sensory or otherwise, have less effect on associated material than on detached. This is proved not only by the fact that more words

are remembered from an associated list after a distraction, but also by the important fact that practically no words are recovered from those lost in the case of associated material, whereas many of those lost from an associated list are recovered, seeming to show that the associated material is better organized. By this is meant the grouping of impressions around attitude.

V. This is further proved by the fact that if there is a passive period after a detached list before a distraction intervenes, the effect of the distraction is lessened.

VI. Even where there is an apparently complete loss of associated words they can be recovered to a great extent by the metronome method already described.

VII. This recovery method failed in the case of abstract associated words which are in this respect on a par with the concrete detached words.

VIII. The effect of attention in the case of associated material was an aid, but not so in the case of detached words.

IX. That motor accompaniments are an aid, provided they are not new or unusual, as then they act the same as another attitude intervening. If the words are grouped around some existing set of attitudes, better still if several motor activities are combined, as in the case of writing in the air, they are remembered better. This combination of motor activities is really a motor definition of attitudes which in turn is a compounding of reflexes.

X. Disturbances coming in the middle of the list are not so effective on memory as when coming at the end. In some individuals a distraction may even reinforce what went before, but in the majority of cases it effaced what went before and reinforced what came afterwards. The greatest effect of shocks on memory is retroactive.

REMARKS

It is not our purpose to go into the physiology of the brain processes which are at the basis of memory. That has been done elsewhere as well as the knowledge of such will allow. Leaving that aside, a few stray notes on some points may not be out of place.

From the experiments as they stand it would seem to be an evident conclusion that pleasant impressions are remembered better than unpleasant. Such a conclusion is to be taken with care. It may be that the unpleasant things are remembered, potentially just as well the pleasant, but their expression in the normal individual may be suppressed. They arouse attitudes or reactions which are just as intense as the pleasant and that is the reason why both classes are remembered better than the indifferent, which in all probability are completely dropped. The unpleasant impressions may have made connections with old attitudes, old states of consciousness in the larger sense. These old ones may be completely suppressed, and the new ones share the same fate. Abnormal cases show us that these old experiences, possibly long since absent from self-consciousness still play a part on incoming impressions. They still play it as psychophysical attitudes. This then is in all likelihood the explanation of the experiments dealing with pleasantness and unpleasantness. One subject who always made a good record with unpleasant words took this means, without knowing it, of course, of expressing in a dislocated way some of his personal feelings, which were usually well masked. Another subject always remembered unpleasant colors for the reason that some brown colors aroused an intense antipathy to the whole experiment, notwithstanding the fact that he was something of an artist. The reason has lately been found, by experimental methods as a continuance of this investigation, to have been a long forgotten experience of childhood¹—one that was vividly emotional. In a general way this holds true of the whole investigation.

It may be worth while to make a note in regard to the memory of concrete and abstract words, and the effect of distractions on them. Impressions which take a large part in the actual contact of the organism with its environment will arouse more attitudes, and they will be more habitual and ingrained than those impressions which do not perform such a function. They will have greater emotional value, greater feeling value, and will represent a greater number of instinctive or reflex reactions in one direction. Such are

¹Cf. JOURNAL OF ABNORMAL PSYCHOLOGY, April-May, 1912.

concrete words, hence they are better remembered, less disturbed by distractions, and even when apparently banished by some cause they are less liable to complete loss. To a large extent the opposite is true of abstract words. They serve the purpose of adjustment to environment, but more remotely.

It may also be stated that if a subject is in an unpleasant "frame of mind," as we say, that is, if the subjective psychophysical attitudes are of a certain kind, and if a certain incoming impression does not arouse a very strong attitude of its own, then it will take on the tone of the complex existing at that time. The converse is true of pleasant complexes. Impressions which harmonize with the existing attitude stand a good chance of being well remembered. Psychophysical attitudes then select from impressions those that are remembered by way of conscious reproduction. Inhibition or suppression, of course, may take place as already explained. The cause of any existing attitude may be said to lie in the response to some previous impression or impressions with a high emotional and feeling tone, and which were not allowed at the time adequate expression in the normal way. Distractions are also most effectual when they arouse intense psychophysical attitudes. When they are very intense, as in the case of accidents, then much is forgotten that happened before and after the accident. Our work shows the effect, on the whole, is to influence what preceded the accident.

When we come to associated and dissociated words the matter is not different. We have seen that if impressions arouse a strong psychophysical attitude they stand a good chance of being remembered. Some limitation must be put on that statement. If several impressions come in close sequence to one another, and, as is probable, they arouse quite different psycho-physical attitudes, then the various combinations of reflexes which give expression to these attitudes will be mutually inhibitory. In this way inhibition takes place, and thus many words in a dissociated list are lost. One psycho-physical attitude will cancel or partly cancel another. To this can also be added the effect of ideas already suppressed. In associated words only this

last feature is operative to banish them. The impressions are all centered around one central attitude and hence this mutual inhibition is absent. Not only are they centered around one central attitude, but around one which in most instances is well established.

Much is now written about mental complexes or constellated ideas. This constellating or complexing seems to be brought about by the actual or potential reactions of the organism. Physiologically, it may be said that ideas are grouped and unified by the compounding of reflexes, that back of emotions and feelings are well-defined and well-established reflex expressions. To include this and also to keep in sight the part which appears in consciousness, the term psychophysical attitude is convenient. These much ignored initial responses are the background and foundation of our whole mental life. To include all responses, then, to include consciousness and that small part called self-consciousness (by some this latter is wrongly called consciousness and the word is denied further extension), to include organic feelings (a poor term), also many reactions which never come to self-consciousness but which are undoubtedly the most important, and on which the stress is here laid—for all this we use the term psycho-physical attitude. Consciousness would be a much better word for the organism's total reactions, and then self-consciousness, attitude, reflex, etc., could be used to mark off the various ways of functioning.

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APPENDIX

Example of Pleasant List:

Warm, income, perfect, amiable, delightful, hopeful, spring-time, kind, elegant,

divine, lovely, home, best, pleasant, gorgeous, truthful, good, rapture, healthy, golden.

Rich, dream, clever, joyful, rose, skill, laugh, lily, tidy, daisy, strong, flower, merry, gentle, honest, clumsy, cottage, sweet, sincere, polite.

Example of Unpleasant List:

Defeat, drear, dirty, shriek, drown, false, skull, cringing, scold, sigh, groan, whine, crape, woe, knife, vulgar, sullen, rude, choke.

Example of Indifferent List:

Request, ability, order, need, made, great, about, relish, suppose, cousin, answer, morning, child, earth, view, start, number, enough, bush, again.

Example of Associated List:

Field, trees, orchard, breeze, reaper, stream, river, meadow, clouds, mower, brook, forest, garden, road, cottage, woods, swamp, plain, hay, cut.