

AN INVESTIGATION IN TO THE EFFECTS OF TIME ON MEMORY

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1.0 Abstract

Peterson & Peterson's studies show that traces of memory disappeared over a period of time from short-term memory. Baddeley & Hitch and Atkinson & Shiffrin produced models of memory that state rehearsal is necessary to encode short-term memories into longer-term memories. However, Craik & Lockhart argued that cognitive processes encode information to long-term memory and stated that

~~more meaningful information is encoded to long-term memory.~~

My study sets out to test the prediction that a time delay will affect the amount of information that can be recalled from memory.

The participants will be given a stimulus material to watch. Half the participants will answer questions immediately after the viewing and half after a 1-week time delay. The study was a laboratory experiment and individual group design with two groups of four female and one male answering questions on the stimulus material.

Comparisons between the free recall of information by the two group conditions were analysed and statistically tested by the Mann-Whitney test. The results suggest that less relevant information is displaced or subject to trace decay from short-term memory and more meaningful information is encoded to long-term memory over the delayed time period.

The supporting theories have useful applications for student revision and memory techniques in general.

2.0 Introduction

Memory is one of the earliest areas of psychology to be studied. ~~Erwin~~ ~~Hermann~~ ~~Ebbinghaus~~ (1885/1913) conducted experiments that demonstrated that memory decreased as time increased. Although Ebbinghaus' work can be criticised, as he was both the experimenter and the participant (and therefore, his findings could be biased) his work formed the basis of many other experiments and theories that try to understand the complex cognitive processes of memory and forgetting.

There is a general consensus among psychologists that we possess the ability to store and retrieve memories for both short and long periods of time and that there are two distinct types of memory: short-term and long-term memory. Short-Term Memory (STM) has a very limited capacity (i.e. it doesn't hold very much) and a short duration (it doesn't last for very long) whereas Long-Term Memory (LTM) has an unlimited capacity and duration.

Several popular models and theories of memory have aimed to explain why and how some information is encoded and stored in the short-term memory and other information undergoes a different encoding process that transfers some memories to the long-term memory. ~~Allison & Shiffrin~~ ~~Models of Short-Term Memory~~ (1968) ~~and~~ ~~Ericsson & Smith~~ (1974) ~~Working Memory Model~~ both advocate that information is encoded into a STM store for immediate use and encoded further and passed to the LTM store for retrieval at a later time. In both models the process of storing memories relied on rehearsal to encode the information. In contrast ~~Craik & Lockhart~~ (1972) ~~Levels of Processing Theory~~ argued that the concept of rehearsal alone is not sufficient to account for LTM and that cognitive processes operating at the time determined what is stored in LTM.

An experiment by ~~Ervin~~ ~~Ervin~~ ~~Ervin~~ (1959) demonstrates the duration of STM by showing participants trigrams that they were asked to recall after a set time that increased as the experiment progressed. To prevent the participants rehearsing the trigrams they had to undertake an interference task i.e. counting backwards in three's. They found that participants were able to recall the trigrams after 3 seconds but progressively recalled fewer as the wait time before recall increased and after 18 seconds recall was very poor. ~~James, James & Warr~~ (1975) conducted research into Very Long-Term Memory (VLTM) that demonstrated the duration of LTM using high-school yearbooks where 90% of 392 ex-students were able to name their classmates after 34 years.

Other factors that affect the ability to encode, store and retrieve memories have been investigated, notable studies include ~~Geisler & Coz~~ (1966) / ~~Neisser & Anderson~~ (1970) that consider the serial position of information as it is received (Primacy & Recency Effect).

However, when we consider the concept of being able to remember it is easy to overlook the fact that we can also forget. The reason a memory is no longer present may not be due to the capacity or coding structure of the store (e.g. acoustic/semantic) but that the memory has been forgotten. One theory is that the memory trace simply disappears when rehearsal was prevented; this process is

called the **Trace Decay Theory**, alternatively the task of counting backwards to prevent rehearsal may have resulted in the memory disappearing due to interference.

~~Wang & Norman~~ (1965) hypothesised that recent short-term memories were displaced by more recent pieces of information (**Displacement Theory**) and conducted a study using the serial probe technique. Participants had to remember a list of 16 numbers, they were then given one of the numbers (the probe) and had to state the next number in the sequence. Participants performed well if the probe was towards the end of the list but performed poorly if the probe number was towards the start of the list. They concluded that the later numbers at the end of the list had displaced the earlier numbers in the list.

2.1 Aims - The aim of my study is to conduct a laboratory experiment to demonstrate that a time delay in recalling information will negatively affect the recall capability of the participants.

I would expect the level of accurate recall of information to be highest by those participants who answer questions about a short (10min) video clip immediately after the viewing compared to participants who answer the same questions 1-week after viewing the same video.

Given the fact that previous research has found that memory traces decay with time a one-tailed directional hypothesis to my experiment would be appropriate.

2.2 Experimental Hypothesis – Participants will recall more of the details contained in videotape when questioned immediately after seeing the tape compared to participants who try to recall the same details when questioned after a 1-week time delay.

2.3 Null Hypothesis – Participants recall of details contained in videotape will not be affected by a time delay of 1-week.

3.0 Method

3.1 Design – My research method is an experiment using the Independent Groups design where the participants only take part in one of the conditions i.e. answer questions immediately after viewing the video (GREEN Condition) or after a one week time delay (BLUE Condition).

The participants were split in to the two groups called GREEN and BLUE. The groups were so named to prevent anticipation that they would be the first or second group to answer questions by labelling them 1 & 2 or A & B.

The advantages of the Independent Groups design are:

- There are no problems with Order Effect (the effects of doing better or worse due to practice or boredom when the same participants performing both conditions).
- No participants are lost between trials e.g. participant completes GREEN condition but fails to attend to complete BLUE condition.
- Repeated measures design is inappropriate, as the participants would be answering the same questions for both conditions.

The disadvantages of the Independent Group design are:

- There may be important individual differences between the participants (see 3.2 Participants below).
- More participants are required than with repeated measures design.

The dependant variable (DV) for the experiment is the amount of questions the participant answered correctly and the independent variable (IV) was the amount of time from viewing the video clip to answering the questions.

To obtain that the most accurate results from the experiment the confounding variables were minimised by:

- Standardising the environment by ensuring:
 - All viewed the video in the same place at the same time.
 - The room was set out so that everyone had an equal position of comfort and viewing vantage.
- Standardising the procedures by ensuring each group were:
 - Given exactly the same instructions (BLUE 1-week after GREEN), in the same room, at the same time of day.
 - Provided with exactly the same question/answer sheet.

3.2 Participants – The participants were an opportunity sample from the Psychology course at Castle College Sheffield. To minimise the disadvantages of Independent Group design mentioned in 3.1 above I matched the participants in to pairs by gender and age.

Additionally, it can be assumed that all participants were of a comparable intelligence as they were all students on the same educational program, however, it cannot be

ignored that opportunity samples are not totally representative of the target population and this type of sample almost certainly has an element of bias.

3.3 Apparatus & Materials – The stimulus material was a ‘fly on the wall’ situational quiz shown to the participants on a 10 -minute video called ‘My New Best Friend’. The contestant in the video has to pass-off an obnoxious actor as a long lost friend to her real friends and family for a whole weekend. If she goes the whole weekend without confessing she doesn’t know the character actor she wins £10,000.

In addition to the stimulus material the participants were supplied with a set of instructions (see appendix 2) and a question and answer sheet (see appendix 3).

3.4 Standard Procedures – The psychology group were asked as a group if they would take part in an experiment in to memory. They were given the opportunity to decline within the forum or to approach me individually to decline. When the opportunity sample was established the following procedures were undertaken:

1. The video room was arranged to ensure each participant had an equal position of comfort and viewing vantage.
2. The participants were invited to sit where they wanted to in the room and asked if they were comfortable and if they had a good viewing position.
3. The participants were given the opportunity to withdraw if they were unhappy with any aspect of their involvement.
4. I read the standardised instructions (see appendix 2) and asked if everyone understood what was expected of them?
5. The participants were given the opportunity to withdraw if they were unhappy with any aspect of their involvement. I also told the participants that they could ask to leave the experiment at any time during the video if they found any of the source material offensive or distressing.
6. The lights were dimmed and the video was played
7. The participants were split in to two groups of five and the groups were called the GREEN & BLUE groups. As previous stated they were so designated to avoid experimental apprehension due to being labelled group 1 or A.
8. The BLUE group were invited to leave the viewing room and the GREEN group remained behind.
9. The GREEN group were given a standard question & answer sheet (see appendix 3) and I read through the instructions at the top of the sheet. I explained the following points:
 - a. We wanted the participants to answer the questions in the order they were asked and to leave answers blank if they could not remember the information the question solicited. This was to avoid cued recall i.e. information in a later question reminding them of the answer to an earlier question.

- b. Not to guess answers as this is an experiment in to free recall of memory and guesswork could give a negative or positive distortion to the results.
 - c. Their identity and results would remain anonymous at all times, however, the results they produced would be analysed as part of the experiment.
10. The participants were given the opportunity to withdraw.
 11. The answers were completed collected and retained by the experimenter.
 12. The Condition BLUE group were taken through exactly the same procedure 1 - week later.

3.5 Controls & Ethics – To ensure the well-being of the participants taking part in the experiment I made a conscious effort to ensure:

- No deception took place.
- Each participant understood the aims of the experiment and what was expected of him or her. Emphasis was placed on the confidentiality of the participant and results to ensure they did not feel apprehensive about their performance and to ensure they did not feel it was necessary to perform differently during the experiment to satisfy my experiment requirements (demand characteristics).
- Each participant gave informed consent before taking part.
- All participants were given the right to withdraw at any time and were offered feedback/ debrief if they had any concerns before, during or after taking part in the experiment.
- Total confidentiality was guaranteed at all stages of the experiment
- To protect the participants from harm I explained before showing the video that it contained strong language from the outset and scenes where non - consenting people were put in embarrassing situations.

3.6 Pilot Study – To ensure the processes and procedures satisfied the design needs of the experiment two small-scale trial runs were held. The first study was on a family group. This pilot dry run highlighted that two of the questions were repeated and one was grammatically incorrect. The feedback from the first pilot study was that they thought the repeated questions and instruction not to return to previously asked questions was some type of deception / psychological trick, therefore, it was important that the repeated questions were deleted. The second pilot study was conducted on a non participating student group and it met the design and proved the processes and procedures.

4.0 Results

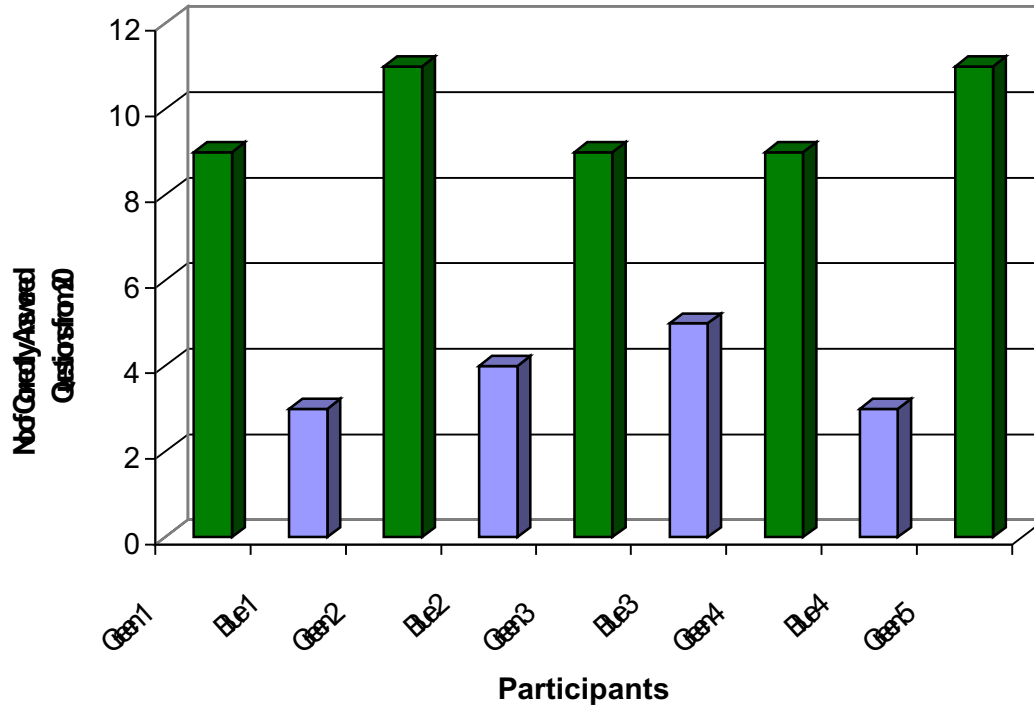
4.1 Raw Data

Condition GREEN No time Delay	Correct Answers	Rank	Condition BLUE Time Delay	Correct Answers	Rank
Green 1	9	6	Blue 1	3	1.5
Green 2	11	8.5	Blue 2	4	3
Green 3	9	6	Blue 3	5	4
Green 4	9	6	Blue 4	3	1.5
Green 5	11	8.5	*	-	-
Totals	49	35	Totals	15	
Mean	9.8		Mean	3.75	
Median	9		Median	3.5	
Mode	9		Mode	3	
Range	2		Range	2	

* Participant Blue 5 failed to attend the second section of the experiment. Due to the independent measures design I decided that although the absence was regrettable it would not distort the findings significantly enough to abandon the experiment.

4.2 Graphical Representation of Results

Condition GREEN (No Delay) & BLUE (Time Delay)



For the Mann-Whitney test of statistical significance and analysis of result see Appendix 4 and Section 5.0 Discussion.

5.0 Discussion

5.1 Explanation of Findings – The key findings of the experiment were that the participants who answered the questions immediately after viewing the stimulus material (GREEN Condition) had a significantly higher accurate recall than the participants who answered the same questions after a 1-week time delay (BLUE Condition).

These basic findings support the original Aims and Hypothesis stated on page 6. However, it is insufficient and presumptive to assume it is simply the time delay that produced the results, deeper analysis is required in to the reasons why t he time delay affected the results.

5.2 Relationship to Background – The aim of this section is to try to understand why the time delay affected the results by considering psychological models and theories mentioned in my 2.1 ~~Method~~ and linking my results to that research to corroborate my findings.

~~Leason & Leason's~~ (1959) research demonstrated that memories held in the STM disappeared as a result of trace decay. Therefore, it can be argued that the GREEN GROUP remembered more information from tthe video because the traces were stronger than the BLUE Groups memories of the video that had decayed during the 1-week delay.

However, when I analysed the raw data I was concerned at the low level (<50%) of recall of the GREEN Group. Therefore, I analyse d the results deeper (see Appendix 4), this analysis shows that nearly 50% of the questions were related to information that came during the first 120 seconds of the video i.e. 10 pieces of information in quick succession. This means that the participants had little or no time to rehearse the information and store it in longer-term memory as suggested by ~~Atkinson & Shiffrin's~~ and ~~Scoville & Milner's~~ models of memory.

This being the case I could just assume that the earliest information had been displaced (~~Wagn & Navon's~~ 1965) from STM, additionally, the displaced information would be the earliest information in the video (as researched in ~~Geze & Coz's~~ primacy and recency theory). However, half of the information recalled by both groups related to events earliest in the video, the question was why did they remember it and forget some of the later information?

Further analysis shows that the content of the earliest information in the video was more personal and therefore more meaningful than the forgotten information e.g. job, car, money, university and time were remembered versus budgie's name, nice to animals, leaving a box and her home town were forgotten. This analysis supports ~~Craik & Lockhart's~~ levels of processing theory that states ~~whomore is more meaningful is more memorable~~. In this instance the participants had a higher level of recall because the information they retained was internalised (relevant to them) therefore, more meaningful information.

5.3 Research Limitations and Modifications – Although my experiment demonstrated what I had predicted and achieved my aims there are several limitations to applying the findings to the general population.

1. The opportunity sample was too small and not representative of a general population only a target population that can be identified as A Level students between the ages of 18 – 22.

To improve the sample population I could increase the number and mix of participants or repeat the experiment and target more specific populations e.g. children 5 – 10 yrs old: children 11 – 16 yrs old: adolescents 17 – 20 etc. The advantage of this method would be that I could look at target populations and/or group the results and look at determining a 'normal' ability to retain information using the standard deviation of statistical analysis.

2. The design used (Individual Group) had two key disadvantages:

- I. There is a high likelihood of experimental bias as my fellow students may either try to hard to support me or purposely give incorrect answers to sabotage the results of my coursework experiment. Either of these behaviours would give experimental bias.

Therefore, the results would have more external validity and generalisability if I repeated the experiment using a random sample.

- II. There is a high likelihood that key individual differences could affect the results. Where possible I matched the participants by age and gender. However, I did have one participant for the second condition dropout giving unbalanced groups. I also had two participants (one male and one female) possibly from different cultural backgrounds in the second condition but not in the first condition.

Therefore, it would be more accurate to use matched pairs from the random sample.

3. Finally, the early grouping of the questions identified at the analysis stage could be built in to the design rather than being an inadvertent consequence.

To achieve this the spread of the questions could be more even through the stimulus material giving the participants more time to rehearse and encode more information to LTM. This would allow more in-depth analysis of the LTM e.g. trace decay, retro and proactive interference, retrieval cues etc. and not just the effects on the STM e.g. trace decay, displacement and interference.

5.4 Implications and Suggestions - The implications of the above limitations are that the findings could be unreliable and therefore they cannot be generalised to real life or to the whole population.

6.0 Conclusion

Conclusions

Although the design could be improved to increase accuracy and generalisability this has been a successful experiment.

Documented research, models and theories support the findings.

In summary, as predicted in my 2.1 Aims the GREEN Group retained more information than the BLUE Group who's recall was negatively impacted by the time delay.

This can be attributed to several factors that affect duration and relevance rather than capacity, ~~wee decay~~ in STM & LTM, ~~wee decay~~ due to inability to rehearse the information and encode it to LTM and ~~wee decay~~ of other information during the time delay.

However, as stated in 5.4 Implications and Suggestions the implications of the above limitations are that the findings could be bias / unreliable and therefore they cannot be generalised to real life or to the whole population without taking account of the modifications suggested in 5.3 Limitations and Modifications.

7.0 Appendices

APPENDIX 1

Testing the Statistical Significance of the Experimental and Null Hypothesis using the Mann-Whitney Test

See results table on page 12.

Smaller sample Condition Blue

Sum of Ranks in smaller sample (T) = 35

Number of participants in smaller sample (N_A) = 4

Number of participants in larger sample (N_B) = 5

Formulas: $U = N_A N_B + (N_A(N_A + 1)/2) - T$

$$U = (4 \times 5) + (4(4 + 1)/2) - 35$$

$$U = 20 + 10 - 35$$

$$\underline{U = -5}$$

$$U' = N_A N_B - U$$

$$U' = (4 \times 5) - (-5)$$

$$U' = 20 + 5$$

$$\underline{U' = 25}$$

Therefore, comparing U & U', U is the smaller value. The calculated value of U' (25) is checked against the Mann-Whitney tabled value for a one-tailed hypothesis at 5%.

	N _A = 5
N _B = 4	2

Conclusion. As (U') **25** is greater than **2** from the Mann-Whitney table the Null Hypothesis should be rejected i.e. Participants recall of details contained in videotape will not be affected by a time delay of 1-week.

Instructions

Questions

Book & Study References

APPENDIX 2 – INSTRUCTIONS TO PARTICIPANTS

You have given your permission to participate in our experiment.

The experiment we are carrying out is about memory.

You will all be shown a short video clip (approx. 10 mins) after that you will be given some questions about the clip to answer.

You are asked to concentrate on the video clip and to sit in a position of good visibility and we would request that you do not take notes as this is a test of memory.

None of your names will be used and we can assure you full confidentiality will be observed.

Although this is not a test of your individual ability the answers you give to the questions will be analysed and used for the purposes of this experiment.

We would warn you that from the outset the video clip does contain some strong language.

You also have the right to withdraw from the experiment at any time be it before, during or after the video clip.

You also have the right to ask any questions about the procedures.

You are asked not to discuss the contents of the video or the questions with other participants until the experiment is fully complete and the results obtained.

Is everyone happy to continue?

Thank you.

APPENDIX 3 – INSTRUCTIONS TO PARTICIPANTS & QUESTIONS

Answer the questions in the order they are given.

Please do not guess answers, this is a free recall memory experiment, only write in an answer if you think you know the correct answer.

Please do not go back to earlier questions that you did not answer, leave them blank.

1	What colour were the tiles on the kitchen wall?
2	What was the Christian name of the two main characters in the video?
3	What was her Job?
4	What colour hair did he have?
5	What was the registration letter of his car?
6	How much did he charge people for taking photographs of their houses?
7	What did he keep calling her Mum?
8	What did he tell her to pick off the tree?
9	Who is she nice too?
10	What was the budgie called?
11	What type of petrol does his car run on?
12	What colour shirt was he wearing?
13	Where does she come from
14	How long did they pretend it was since they had last seen each other?
15	How much was the prize money?
16	Where did they say they had met?
17	How long did he want to leave the box at her flat for?
18	What was the colour of the flowers on the table?
19	What was her Mum carrying when she came in the room?
20	What type of scene was on the backdrop at the photo-shoot?

APPENDIX 4 – DATA ANALYSIS

APPENDIX 4 DATA ANALYSIS												
SORTED BY POSITION IN VIDEO						SORTED BY %age CORRECT ANSWERS						
Q	GREEN No CORRECT	BLUE No CORRECT	%	CONTENT	POSITION IN VIDEO	Q	GREEN No CORRECT	BLUE No CORRECT	%	CONTENT	POSITION IN VIDEO	
3	5	0	56	JOB	E	10	0	0	0	BUDGIE	E	
5	5	0	56	CAR REG	E	13	0	0	0	COVENTRY	E	
9	1	0	11	NICE TOO	E	1	0	0	0	TILES	M	
10	0	0	0	BUDGIE	E	18	0	0	0	FLOWERS	M	
13	0	0	0	COVENTRY	E	9	1	0	11	NICE TOO	E	
14	4	1	56	3 YRS	E	12	1	0	11	SHIRT	EML	
15	2	2	44	£10K	E	7	2	0	22	MRS S	M	
16	5	2	78	UNIV	E	17	3	0	33	BOX	E	
17	3	0	33	BOX	E	2	1	2	33	NAMES	EML	
2	1	2	33	NAMES	EML	19	3	0	33	FLOWERS	M	
4	3	2	56	HAIR	EML	15	2	2	44	£10K	E	
12	1	0	11	SHIRT	EML	11	4	0	44	PETROL	M	
8	5	1	67	COCONUT	L	3	5	0	56	JOB	E	
20	5	3	89	TROPICAL	L	5	5	0	56	CAR REG	E	
1	0	0	0	TILES	M	14	4	1	56	3 YRS	E	
6	5	0	56	£70	M	4	3	2	56	HAIR	EML	
7	2	0	22	MRS S	M	6	5	0	56	£70	M	
11	4	0	44	PETROL	M	8	5	1	67	COCONUT	L	
18	0	0	0	FLOWERS	M	16	5	2	78	UNIV	E	
19	3	0	33	FLOWERS	M	20	5	3	89	TROPICAL	L	

E Early in video

M Mid point in video

L Late in video

EML Appears throughout video

APPENDIX 5 – BOOK REFERENCES AND STUDY CREDITS.

Books:

Psychology for AS Level – Michael W. Eysenck & Cara Flanagan

Revise Psychology for AS Level – Roz Brody & Diana Dwyer

Psychology for A2 Level - Michael W. Eysenck

Revise Psychology for A2 Level - Diana Dwyer & Clare Charles

Supporting Study Credits:

Ebbinghaus (1885/1913) - Forgetting

Peterson & Peterson (1959) – Duration of Short-Term Memory

Atkinson & Shiffrin (1968) – Multi-Store Model

Baddeley & Hitch (1974) – Working Memory Model

Craik & Lockhart (1972) – Levels of Processing Theory

Baird, Baird & Wittlinger (1975) – Very Long Term Memory

Glanzer & Cunitz (1966) – Primacy & Recency Effects

Rundus & Atkinson (1970) – Primacy & Recency Effects