International® Baccalaureate

3/CS

Internal assessment: group 3 individual candidate cover sheet

Submit to: **Moderator** Arrival date: **20 Apr / 20 Oct** Session: MAY

School number:

School name: .....

- *Write legibly using black ink and retain a copy of this form.*
- *Complete this form in the working language of your school (English, French or Spanish).*
- *Attach one completed copy of this form to the work of each candidate represented in the sample.*

Subject: PSYCHOLOGY Level: HIGHER

Candidate name: _

Candidate session number:

Title(s) and dates of work: (complete if appropriate)

(1) An Investigation into the Effects of Musical Interference on the Rehearsal Stage of Memory

(3)

(4)

Teacher declaration: To the best of my knowledge, the material submitted is the authentic work of the candidate.

Signature of teacher: ..... ✓ Date: 25/3/11

Candidate declaration: I confirm that this work is my own work and is the final version. I have acknowledged each use of the words or ideas of another person, whether written, oral or visual.

Candidate's signature: ... . Date: 22/03/11

V

Types of work undertaken (to be completed by teacher)
for example, written assignment/essay/case study/fieldwork/portfolio/photography/video/computer)

Business and management SL: the issue or problem selected for the commentary must relate to the SL syllabus and refer directly to a single business organization *(Business and management guide, March 2007, page 52).*

Experimental Study – cognitive perspective

Other relevant information (where appropriate) V

Robert worked with Matthew Paisl in the design and data collection but wrote up the report independently

Teacher support (where a candidate could not have completed the work without substantial support, please indicate)

Psychology HL

Internal Assessment

An Investigation into the Effects of Musical Interference on the Rehearsal Stage of Memory

Word Count – 1,997

Abstract

Emulating the investigation into the effects of interference into recall ability conducted by Peterson and Peterson, our experiment aimed to discover whether or not the presence of musical interference during the rehearsal stage of memory affected people's ability to remember information.

Our hypothesis states that musical interference would have a detrimental effect on recall ability. We therefore set up a memory test, in which participants were given a list of words to read for a set amount of time. Following this period, they were given a brief period in which to attempt to commit these words to memory without the sheet in front of them. The two groups into which our participants were placed differentiated at this point, with one group rehearsing in silence, and the other being made to listen to loud music. Following the rehearsal period, they were given an unlimited amount of time in which to write down as many of the words as they could remember.

These results were recorded and analysed, revealing those *with* interference to recall and average of 4 fewer words, which supports our hypothesis that the interference would have a derogatory affect on recall ability. Our Mann-Whitney-U test results showed that our two fields of data were significantly different from one another, in that the interference group recalled fewer words.

Contents

Introduction

Cognitive psychology deals with mental processes such as memory. One theory, put forward by Atkinson and Schifrin, suggested three separate memory stores with varying capabilities to retain information. These were the Sensory Memory (lasting moments), the Short Term Memory (stretching to 18-30 seconds) and the Long Term Memory, which can last anything from a few minutes to a lifetime. They also suggested that in order for new information, which is being stored in the STM, to be transferred to the LTM, a rehearsal process must take place, wherein information is consciously, repeatedly processed in an attempt to 'commit it to memory'. This was expanded my Baddeley and Hitch (1974), who proposed the Working Memory model, wherein the short term memory was expanded to include the Visio-spatial sketchpad[1], the Central Executive[2] and the Phonological Loop[3]. The part of this theory which is relevant to our study is the rehearsal stage of memory encryption, falling between the STM and the LTM. The Episodic Buffer was added to the model in 2000 to act as a medium between these sections and the LTM.

It is the rehearsal stage of memory which Peterson and Peterson investigated in 1959. Interested in discovering whether interference during this stage could affect our ability to transfer information from the STM into the LTM, they conducted the following experiment[4]:

- Participants were given the task of remembering a trigram[5]
- After this, different groups were given varying amounts of time in which to perform an *interference task* before being asked to recall the trigram. Different groups were given 3, 6, 9, 12, 15, or 18 seconds between reading the trigram and recall.
- Participants were then asked to recall the trigram.

The results showed that although there was a 50% recall success rate after a 3 second interval, this dropped to a mere 5% after 18 seconds, which suggests that increased interference reduces encoding ability and causes memory decay. Here, Peterson and Peterson used interference tasks to prevent rehearsal during the delay period. This increased the validity of the results, in that people were placed on an equal plain in regards to recall ability, as all participants were prevented from rehearsing, to the extent that those with greater rehearsal ability would have no advantage. Similarly, other factors affecting recall were carefully removed, such as the use of trigrams instead of words, the semantics of which could have had specific relevance to the participant, and hence increased the probability of recall. However, the ecological validity of the lab experiment was low: it is also rare that a person has to remember a trigram in real life.

---

[1] This is concerned with the storage of visual and spatial memory.
[2] This is concerned with the allocation of information to the appropriate sections of the STM, as well as problem solving.
[3] This is comprised of the phonological store (one's inner voice) and the Articulatory Control Process (one's inner ear).
[4] http://www.psychologistworld.com/memory/peterson_decay.php
[5] A trigram is a group of three random letters which do not form a word.

In designing my partial replication of this experiment, it was important to take into account the points of evaluation mentioned in the above paragraph. I wished to investigate a smaller point of the Peterson and Peterson study, in that I was interested in discovering whether or not interference *does* prevent rehearsal (therefore choosing *not* to vary the time period in my experiment), or whether it can be blotted out and ignored if a task is being concentrated on. Therefore my aim is to answer the following research question:

To what extent does musical interference during the rehearsal stage of memory encoding affect recall ability?

Through my research, I found that the best experiment for me to base my hypothesis on was that of Salamé and Baddeley (1983), who investigated whether irrelevant music (as interference), played to participants during a rehearsal period, affected their ability to remember numerical sequences, and found that it had a detrimental effect, causing them to recall fewer words. Therefore, my hypothesis is as follows:

Null Hypothesis – Musical interference (or the absence thereof) during the rehearsal stage of memory has no effect on recall ability; any difference in performance is due to chance or some other variable.

Experimental Hypothesis - Musical interference during the rehearsal stage of memory has a significant, derogatory effect on recall ability – therefore, interference will cause participants to recall fewer words than those with no interference. This is a directional Hypothesis

As my experimental design and hypothesis are justified by those of Peterson and Peterson, who believed that interference prevented rehearsal, I too shall work upon this assumption and attempt to support it in my results. They are also justified by the *results* of Salamé and Baddeley who discovered interference to have a detrimental effect on recall ability.

Experimental Method

Design

Independent measures (which involve the use of two groups, a control group (who were not given interference) and an experimental group (who were given interference)) were used for this experiment as the main task involved committing a list of words to memory. The use of *repeated measures* would have introduced a new variable: a new word list. There is also a risk of the practice effect affecting results.

Our dependant and independent variables were as follows:

IV: The presence of musical Interference during rehearsal time. This was operationalised by simply turning the selected music on at the start of the

rehearsal period for those participants in the Interference Group whilst the control group sat in silence for the rehearsal stage.

DV: The number of words, from a list of 30[6], correctly recalled. This was measured by counting the words written down by the participants in the recall period and cross referencing them with an original list to ensure that they were correctly recalled[7]:

Ethics were also taken into account in that we ensured that the experiment was totally safe for all participants, who were given an informed consent form before taking part[8]. Immediately after the experiment, the participants were verbally debriefed[9], wherein the aim of the experiment and details of the examination method were explained. Participants were also offered the opportunity to supply their email address so that we might send the results to them.

Participants

An opportunity sample, which involves the use of any available/willing individuals as participants, was used, comprising of 24 individuals who walked through the Sixth Form Centre. We tried to make the sample as comprehensive as possible in that participants could be any gender, ethnicity and from any educational background[10]. An age restriction of 17-60 was enforced. However, our target population comprised of parents and students at an open day, and an average participant age of 23 was achieved and all were Caucasian.

Procedure[11]

After signing the informed consent form, the participant was sat down with the word list face down in front of them it was explained that they had 1 minute to read the word list with no writing materials; the word list was then provided. If the participant was in the interference group, they put on the headphones (through which the music will be played) at this point, so that time was not wasted later. After one minute, they were told that they had 25 seconds rehearsal time in which they would not have access to the list; this then took place. For participants in the interference group, the music was started at this time; the participants in the control group sat in silence for the rehearsal stage. After twenty five seconds, participants were told that they had an unlimited amount of time in which to write down all the words that they could remember; the music, for those in the interference group, was stopped at this time.. When the participant expressed that they had recalled as many words as

[6] Details of the word list are provided in Appendix I

[7] The song used in interference; the lengths of time allotted; the location of the experiment; length of word list provided; source of words. Exact details of each variable are provided in Appendix II

[8] A copy of this form is available in Appendix III, wherein the rights given to participants are detailed (excluding the right to anonymity which was expressed to the participant verbally by the experimenter)

[9] Details of this debrief are available in Appendix IV

[10] However the majority of participants were boys from a highly selective London-based secondary school and their teachers/parents.

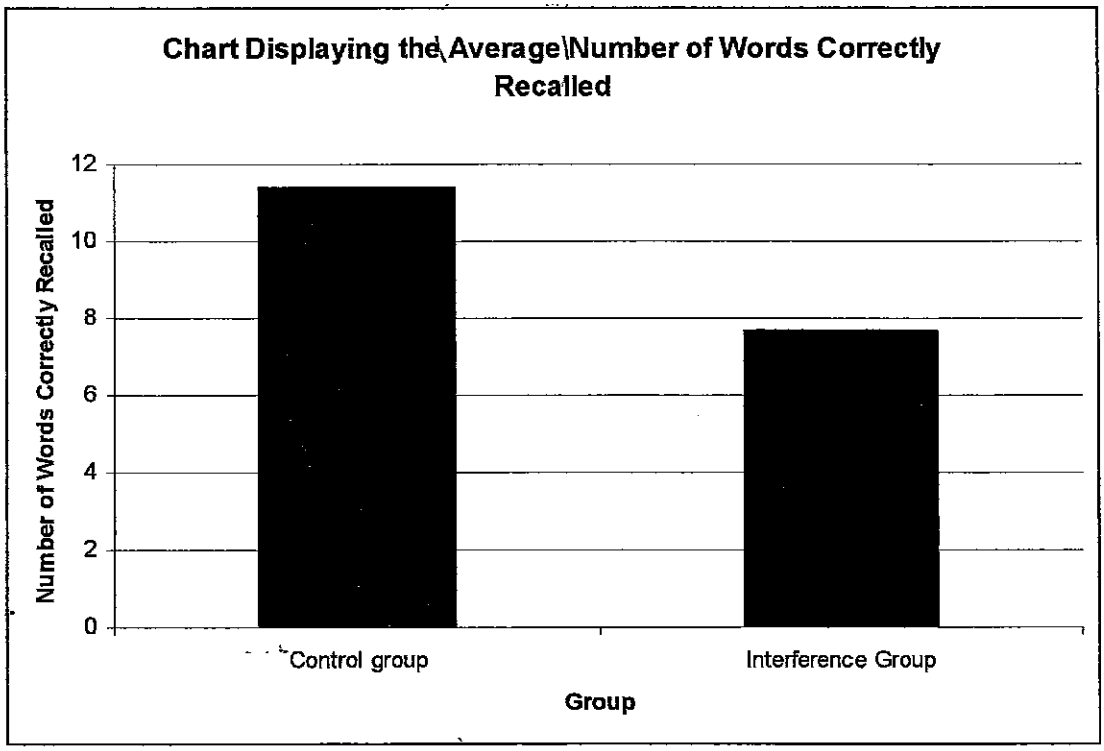
[11] The full procedural instruction list is detailed in Appendix V

possible, they were debriefed and dismissed. It is also important to note the following characteristics of our procedure;

- The experiment was conducted by a single researcher, controlling the music, stop watch and paperwork.
- Participants were allocated into groups on an alternate basis (i.e. Participant 1 went into the control group, participant 2 went into the interference group and so on) Participants were tested individually.
- The lengths of time are mentioned in Appendix IV and footnote 7
- Ethical guidelines were followed as detailed in the Informed Consent Form in Appendix II

Results (descriptive)

Upon the collection of our data[12], we noted that, despite a few anomalies, the participants in the control group tended to remember more words than those who were given interference, as expressed by this bar chart showing the average number of words remembered in each group. The calculation of the mean average was appropriate as the results take the form of a score, which is classed between ordinal and interval. I am therefore treating these results as quasi-interval, for which the calculation of the mean and standard deviation is appropriate:



The number of words remembered here are out of a possible total of 30

[12] Raw data is supplied in Appendix VI

Presented as a table, our results are as follows:

Table to Show the Mean and Standard deviation values of the number of words correctly recalled by the control and interference groups (out of 30)

	Control Group (out of 30)	Interference Group (out of 30)
Mean	**11.42**	**7.67**
Standard Deviation	**2.23**	**1.50**

The validity of the results is also confirmed by the small standard deviations[13] calculated.

Inferential Statistics – Mann-Whitney-U Test

Due to the use of independent measures and the decision to treat our data as ordinal in regards to inferential statistics, we decided to perform a Mann-Whitney-U test[14] to ensure that there is a significant difference between the two samples. This test yielded the value:

$$U_1 = 11$$

Comparing this U_{calc} value of 11 to, the **Ucrit** value which corresponds to your sample numbers (**N = 24**), in this case **Ucrit = 27,** we found this data to be significantly different at **P<0.01.** This means there is only a 1% probability of our results being due to chance.

As U_1 is less than the **Ucrit** (in this case U_1) we can reject the Null Hypothesis and state that there is a difference between the number of words remembered by the control group and those remembered by the interference group; that those in the control group remembered significantly more.

Discussion

As mentioned above, the results clearly indicate a causal relationship between the IV and the DV. This clearly supports the assumptions made by Peterson and Peterson (1959) in that interference during the rehearsal stage of memory seems to hinder the ability to encode information for recall at a later stage. Having the conscious focus of the participants shift from the words to the music has caused the participants to fail to continue to consciously rehearse the words, and therefore not encode them; this is supported by the results of Salamé and Baddeley (1983), and applied directly to the rehearsal stage of the Multi-Store Memory model[15]. I would

[13] See Appendix VII for details of standard deviation calculation
[14] The full process of the test done is supplied in Appendix VIII
[15] As defined by Atkinson and Shiffrin.

also suggest that musical interference occupies the phonological loop in the Working Memory Model[16] preventing the use of the inner voice to aid rehearsal. Peterson and Peterson focused more directly on time as the limiting factor, with interference as a given detractor, and we believe that our results substantiate theirs in that they solidify their assumptions about interference and increase the validity of their main results. Our results are shown to be reliable due to the small standard deviation values.

Our experiment was limited in several ways. For instance, the environment in which I was working was very noisy; working in a public area proved to be highly distracting. To this extent, even those participants who were in the control group received some degree of interference from general noise in the area. Occasionally, individuals also approached participants and began speaking to them, having not realised that they were taking part in an experiment. This caused the anomaly figure of '8' in the control group, which was the result of a woman who could remember no further words after having been interrupted. This reduces the reliability of our results. Therefore, for future replications of this experiment, I would suggest conducting it in private conditions, with participants alone in a room with an experimenter. I also noted that some time was lost in the transfer of materials such as pens and paper, and a more efficient method of doing this was required to prevent rehearsal in this time. It would perhaps be more efficient to have all materials available to the participant from the start of the experiment. Ideally, the whole procedure could be computerised, with automated transfer between sections of the experiment (including the starting and stopping of the music), and involving participants typing the words they can recall. This minimises transfer time and allows for the most reliable results. However, I believe this to be a highly valid experiment as our word limit was of a length which allowed difference participants to recall both high and low percentages of the words in the allotted time depending on whether or not interference was present. Due to the small size of the sample however, generalisability of the experiment was limited.

As we used music for our interference, I was inspired to wonder whether or not different types of music affect rehearsal differently; as many pop-psychology articles claim that classical music aids memory and rehearsal, it would be interesting to investigate the scientific basis for these claims. Alternatively, a difference between types of interference could be investigated; for instance, one could ascertain whether visual, audio or tactile interference is more distracting.

In conclusion, our experimental hypothesis was accepted. Our Mann-Whitney-U test showed the two groups of data to be significantly different, in that those in the control group remembered far more words. We can therefore conclude that interference hinders rehearsal and has a negative effect on recall.

Word Count – 1,997[17]

Bibliography

- Atkinson, R.C. and Schiffrin, R.M (1971). *The Control of the Short Term Memory.* Scientific American, 224l pp. 82-90

[16] As defined by Baddeley and Hitch

[17] The word count does *not* include tables, graphs, the abstract, the appendices or titles of any kind; as per the IB guidelines.

- Baddely. A.D (2000) The episodic buffer: a new component of working memory? *Trends in Cognitive Sciences 4*, pp. 1197-23

- Baddely, A.D. and Hitch, G (1971) Working memory. In G.A Bower (ed.) *Recent advances in learning and motivation,* Vol. 8, New York: Academic Press

- Crane, John; Hannibal, Jette – *IB Diploma Program, Psychology Course Companion*; Oxford University Press, 2009

- Peterson, L.R and Peterson, M.J (1959); Short term retention of individual items. *Journal of Experimental Psychology,* 55; pp 193 - 198

- Salamé, P and Baddeley, A.D. (1983) Differential effects of noise and speech on short-term memory. In G. Rossi, *Proceedings of the 4th international congress on noise as a public health problem,* Vol. 2.

Appendices

Appendix I (Word List)

Column
Fern
Raindrop
Serenity
Repression
Restlessness
Galvanize
Bumper
Mercenary
Swift
Fish
Indulgence
Scarf
Poster
Tiling
Speaker
Pen
Slither
Weed
Run
Radish
Novel
Water
Forearm
Model

Fanatic
Holiness
Field
Scissor
Tunnel

Appendix II (variables)

Song Choice – The song chosen was '*Stockholm Syndrome*' by the popular alternative rock group, 'Muse'. This was selected as I believed that its high pace, mild recognisability and powerful dynamics would be highly distracting to the participant.

Allotted Times – Reading: 1 minute. Rehearsal: 25 seconds. Recall: Unlimited

Location of Experiment – The sixth form centre

Length of Word List – 20 words

Source of Words – An internet random word generator was used to produce 20 words of 'medium rarity'

Appendix III (informed consent form)

Before partaking in the experiment, all participants were asked to fill in the following consent form, which is presented exactly as it was at the time of the experiment:

Dear Participant,

We are conducting an experiment with the aim of discovering more about the nature of memory, and we would be highly grateful if you were to agree to participate. The experiment will involve a simple recall test, where you will be asked to read and remember a set of words.

It is our duty to inform you that, by agreeing to participate, you are allowing your score to be used in our results and the formation of our conclusions. At any stage during the experiment, you have the right to discontinue your participation or to request your results not to be used. At the end of the experiment you will be debriefed, wherein the aims of the experiment will be detailed to you. The results will be sent to you via email and if, at any stage, you find you have any queries, you can email us on either:

Or

Via the KCS email system.

I ..... give my informed consent to participate in this experiment.

Appendix IV(debrief)

The following statement was issued to all participants following the experiment:

Thank you for taking part in our experiment. We are investigating the affect of interference, in this case, music, upon people's ability to remember information. When we commit things to memory, we must rehearse the information in our minds before it can be encoded; what we aim to discover is whether musical interference hinders this process, and our hypothesis proposes that it *does*. You took part in or control/experimental group, which is why you didn't hear/heard the music during your rehearsal period. Following today, we shall process these results and draw conclusions from them, are you still willing to allow us to use your data? If so, would you like us to send you the results?

Thank you again for your help.

Appendix V (procedure)

Detailed instructions are here provided for the purposes of replicating this experiment:

1. Achieve willing participant and have them sign the informed consent form
2. Select which group the participant will be in (either the control group or the interference group)
3. Detail the timing to the participant (see footnote 7)
4. Have the participant sit down with the word list face down in front of them, when you are ready with a timing device, give the participant 1 minute to read over the word list with no writing materials. If the participant is in the interference group, have them wearing the headphones through which the music will be played at this point so that time is not wasted later.
5. After one minute, remove the word list and supply paper and a pen (but do not let the participant use them yet) and allow 25 seconds rehearsal time. For participants in the interference group, start the music at this time.
6. After twenty five seconds, stop the music (if appropriate) and allow unlimited time for the participants to recall as many words as they can and write them on paper. Unlimited time at this stage ensures that time restraints and pressure won't hinder recall ability.
7. When the participant expresses having recalled as many words as possible, collect their sheet of paper, debrief them and dismiss them.

Appendix VI (raw data)

	Control Group	Interference Group
	14	5
	11	9
	8	8
	13	6
	9	9
	15	7
	10	8
	9	10
	11	7
	11	9
	14	8
	12	6
Sum	**137**	**92**
Mean	**11.41666667**	**7.666666667**
St. Dev.	**2.234373**	**1.497473**

Appendix VII (Calculations)

It is important to note that although Microsoft Excel was used to calculate the Mean and Standard Deviation of the data, the following mathematical formulas were used:

Average

The average of a set of numbers is ascertained by calculating the mean value. This consists of dividing the sum of all the elements involved, by the number of elements themselves. Or:

$$\text{Mean Average} \quad \frac{\text{Sum of Elements}}{\text{Number of Elements}}$$

Mean Average = $\frac{x_1 + x_2 + x_3 + x_4}{4}$.

Let us look at an example:
Four randomly generated decimals are as follows:

0.087, 0.072, 0.092 and 0.081

If we add these four numbers together, the result is 0.332. Following the method of achieving the average, we then divide this number by the number of elements (in this case four) which will give us the answer: 0.083. This number is the average of these four numbers.

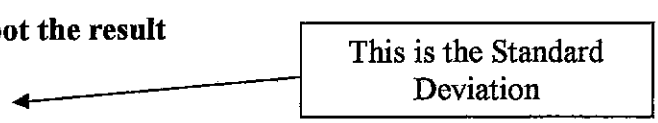
We have used the average result in order to obtain the most accurate result possible. Although one result may have suffered due to experimental error, a repetition of the experiment would allow us to find an average, which is the most accurate result possible. In experiments where the data can vary (even minutely) the taking of an average can be invaluable when achieving reliable data from which to draw conclusions or place in a graph.

Standard Deviation

Although the simple mean of a set of values is very useful, it is also highly beneficial to calculate how 'spread out' these values are. This is where we use Standard Deviation. This calculates how far away your results are from the mean. In all cases, 68% of results will fall within 1SD of the mean, and 95% within 2SD. The higher the Standard Deviation, the further away from the mean the result lies. Standard deviation is calculated by subtracting the mean from every value and square the result of each subtraction. You then add all of these values together. Then, divide by n (the number of values you started with) minus one. The square root of *this* result gives you the standard deviation. This can also be written as the following equation:

$$\sigma = \sqrt{\frac{\sum (x_i - m)^2}{n-1}}$$

Let us look at an example:
If I was to take the same numbers used in the Average calculation:
0.087, 0.072, 0.092 and 0.081
I would work out the standard deviation in the following way:
1. Subtract the mean from each value and then square the result:
0.000016, 0.000121, 0.000081, and 0.000004
2. Add these values together
0.000222
3. Divide this number by (n-1), in this case n = 4
0.0000555
4. Square root the result



0.00745

Appendix VIII (Mann-Whitney-U test calculation)

Let **n1** be the size of the smallest sample (12) and let **n2** be the size of the biggest sample (12). Here, as both are the same, we have:

n1 = 12
n2 = 12

After identifying these values, rank the data from smallest (1) to largest in the following way:

Control Group	Rank	Rank	Interference Group
		1	5
		2.5	6
		2.5	6
		4.5	7
		4.5	7
		7.5	8
		7.5	8
		7.5	8
8	7.5		
		12	9
		12	9
		12	9
9	12		
9	12		
		15.5	10
10	15.5		
11	18		
11	18		
11	18		
12	20		
13	21		
14	22.5		
14	22.5		
15	24		
	R_1 = 211	**R_2 = 89**	

Note that the $\mathbf{R_1}$ **and** $\mathbf{R_2}$ values represent the totals of the ranks in those columns.

Then, to calculate the **U** values of your samples, use the following equation:

$$U = n_1 n_2 + \frac{n_1(n_1 + 1)}{2} - R_1$$

This is done for both samples (the R value is used accordingly) to produce the following **Ucalc** values:

$\mathbf{U_1 = 11}$

$\mathbf{U_2 = 133}$

Using the Mann-Whitney-U test critical values table at a 5% level of significance, select the **Ucrit** value which corresponds to your sample numbers, in this case **Ucrit = 37**