

The Limitations and Flexibilities of Short Term Memory

Psychology Internal Assessment

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3/CS

Internal assessment: group 3 individual candidate cover sheet

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Subject: PSYCHOLOGY Level: HL

Candidate name:

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

- (1) THE LIMITATIONS AND FLEXIBILITIES OF SHORT TERM MEMORY
- (2)
- (3)
- (4)

Teacher declaration

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

Signature of teacher: Date: 31. III. 08

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:

Types of work undertaken (to be completed by teacher)

(for example, written assignment/essay/case study/fieldwork/portfolio/photography/video/computer)

Geography SL: note whether the one piece is *fieldwork* or a *research assignment* and to which theme it is linked.

Business and management SL: note which of the prescribed list of topics/subtopics (*Business and management guide, February 2000, page 45*) the subject matter of the investigation is linked

LABORATORY EXPERIMENT

Other relevant information (where appropriate)

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

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Abstract

The aim of the experiment is to discover the limitations and the flexibilities on short term memory capacity. I approached the investigation through the experiment, Free Recall. The research hypothesis was that number of letters recalled is greater in 'chunked' letters than 'unchunked' letters.

The design applied to the experiment is an independent sampling design, studying number of recalled letters in two different conditions. Diffusion treatment was controlled by separating the participants and not allowing them to speak to one another. Participants were gathered by opportunity sampling, experimenting participants who were available at that time. Based on the results, the research hypothesis was supported; the average number of 'unchunked' letters recalled was around 7, while 'chunked' letters being 18.

I, supporting the research hypothesis, found out that short term memory is limited to 7, but flexible to variety of 'chunks' (or items).

Introduction

The cognitive perspective of psychology states that much of our behavior involves not simply actions, but possesses processes such as perception, memory, problem solving and language. These processes are intangible, meaning that it cannot be directly observed. However, these processes affect human behaviors very effectively.

The cognitive approach proposes that learning may be considered as information gathering based on information processing model. We gather information everyday of our lives. This information may be very important. However, the effectiveness depends on remembering this information. To do this one needs to deal with short term memory first.

Miller contributed his work on STM, his work, "Magical Number Seven" stated that memory span of humans was around seven elements, called chunks, such as phone numbers, and random letters. Chunk is the *basic measure of STM capacity, representing a meaningful unit, such as random letters, numbers or words*¹ However, if the items are not broken into parts but come together to form new chunks, it is easier to remember. Simply said, letters that spell a word are neither independent nor random, and are therefore easier to remember. Hence, attempts to remember longer sequences result in greater forgetting of items, owing to the limited capacity of STM.

The 'father' of STM was actually Ebbinghaus. He was the first psychologist to maintain that STM is limited to six or seven bits of information. Using nonsense syllables, he found about that he could only recall 7 items or less. During his life, he conducted serial recall, which participants recall items in the order they were presented to them. For instance, actors or actresses need to engage the serial recall, when they are memorizing the lines for a play or a movie. Ebbinghaus found out that as time passed by, it was more difficult to recall, and need more time to recall the items he remembered.

The experiment aimed to study how many information remains in short-term memory (STM), using simple stimuli and not allowing the participants to rehearse the material presented to them. They aimed to test the hypothesis that information not chunked together is more difficult to remain in short term memory.

I will conduct experiment, 'Free Recall' on 60 participants, dividing them into two separate groups of 30; experimental group and controlled group. Controlled group will be presented with 15 letters, (e.g., S A T N B C E S P N F O X R T L), to memorize. Experimental group will be presented

¹ William E. Glassman, *Approaches to Psychology (Third Edition)* (Buckingham: Oxford Press, 2000)

'chunked' letters to memorize, (e.g., SAT NBC ESPN FOX RTL) as abbreviations of TV stations. By doing this I could measure the effect of 'chunked' items together as meaningful information.

Research hypothesis is that the number of recalled items will be greater when the words are 'chunked' together than 'unchunked' letters.

If the null hypothesis is true there would be little difference between the number of recalled letters between the 'chunked' and 'unchunked' letters.

Method

Design

This experiment was an independent sample design. The experiment was conducted through two different groups of participants for each of two sets of letters. This will avoid the familiarity towards the experiment.

There are advantages of an Independent Sample design, first, no order effect is present, second, participants cannot guess the aim of the experiment, third, same stimulus lists etc. can be used again, last of all there is no need to wait for the participants to 'forget' the first condition.

The dependent variable of the experiment was the number of 'items' recalled. While the independent variable being the chunked or un-chunked items. The number of items recalled depends on the form of the letters (meaningful or meaningless). The experiment was carefully controlled; during the Free Recall experiment, participants were not allowed to communicate with one another; *diffusion of treatment* was controlled

All the ethical criteria were met; participants were given consent forms to sign, understanding the aim of the experiment. Individual's privacy was protected; their results were kept in discreet. Specific to this experiment is protecting the participants from potential harm to self-esteem as they may be 'at risk' for low memory efficacy. No situation was arisen where participants feel less competent because of the experimental tasks. Last of all there were no deceptions present in the experiment.

Participants

60 participants took part in the experiment, age between 18 and 36; average of 24.23 years old. All the participants are students of G I learning german. Experiment used opportunity sampling, selecting participants based on the opportunity to experiment. The target population is confined to the sample. They were randomly divided into two groups of 30 by random allocation, where everyone in the sample has an equal chance of being in either condition or group.

Materials

The experiment uses two groups of materials. The first are materials for 'unchunked' letters. The second part is the 'chunked' letters to measure the dependent variable.

Procedure

On the day of the experiment, the researcher went into the classroom. The researcher introduced himself to the class and informed potential participants of the nature of the experiment. The

students were given informed consent to sign. Participants were each given an index card. They were not required to put their names down. Between individuals talking was not allowed. They were presented with 'unchunked' letters. This was done orally. The researcher told them around 15 different letters depending on the material. Afterwards, the participants were told to write down what they remember. Index cards with the recalled letters were collected by the researcher. The researcher exits the classroom.

This was repeated in another classroom with a different material; participants were presented with 'chunked' letters (e.g. abbreviations; ABC ESPN).

During the experiment diffusion of treatment is avoided by keeping the participants separate and by not allowing talking. Order effect is also avoided by independent sample design; each participant went through one condition. Although opportunity sampling was used to acquire participants, they were randomly allocated to the groups.

Results

Figure 1 is the bar graph showing the mean number of letters recalled by all the participants when recalling the letters in 'unchunked' and 'chunked' form. It can be seen from the figure one that the mean number of 'unchunked' letters recalled was 7.23 and the mean number of 'chunked' letters was 17.90.

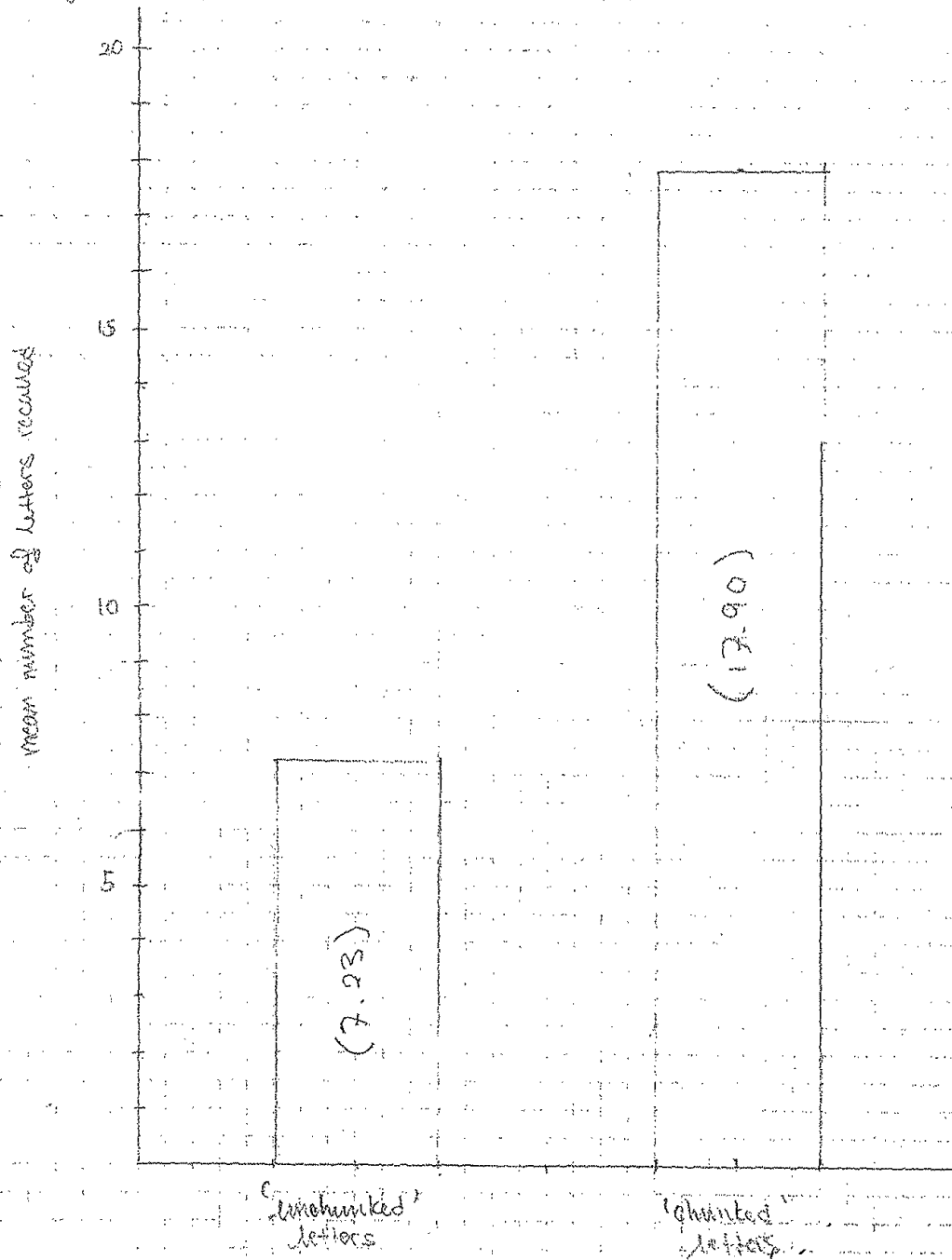
The range was between 4 and 11 numbers in 'unchunked' condition and between 14 and 21 numbers in 'chunked' condition. Last of all, the standard deviation for 'unchunked' condition was 2.60, while 'chunked' condition being 1.77.

Table: Conditions A and B, average values, standard deviation, t-test value

	Condition A	Condition B
Mean	7.23	17.90
Standard Deviation	2.60	1.77
Range	4 ~ 11	14 ~ 21
t-test value	7.32	

To test the significance of the results, an unrelated t-test was used, because it was independent sampling design. It was one-tailed because a direction for the results was predicted. The t value of the experiment (through t-test) was 7.32. For a one-tailed test of t, with $df=58$ and $p=.05$, t must equal or exceed 1.672. The results were found to be significant ($p<0.05$), which means that the probability of the results occurring by chance if the null hypothesis were true is less than 5%. Therefore, the null hypothesis was rejected and the research hypothesis was accepted; there appears to be a real difference in the number of words recalled by 'unchunked' and 'chunked' letters group.

Figure 1: The mean number of letters recalled in 'unchunked'



Discussion

Based on the experimental results, they show that 'unchunked' items were more difficult to be recalled than 'chunked' items. Participants recalled average of 7.23 of 'unchunked' letters, while average of 17.90 of 'chunked' letters was recalled. These mean numbers of two conditions support the research hypothesis that number of recalled of 'chunked' letter will be greater than the 'unchunked' letters. There were significant differences between two groups. Furthermore, this significance can be shown through the student unrelated t-test (see Appendix). Overall, the findings were consistent with the research hypothesis, exceptions of one or two extreme value(s). These extreme values can be explained through the meaningfulness of items. For instance, certain items may have been meant more to one than another. Hence, easier to remember than others for who it's less meaningful.

Referring back to the theoretical evidence, 'Magical Number 7' by Miller, in introduction, the experiment supported the theory. Short term memory has the capacity of 7 plus minus 2 chunks. The group, 'Unchunked' letters, recalled around 7 letters, this is because that letters do not mean anything at all. On the other hand, the group, 'Chunked' letters, recalled around 18 letters, this shows that when the letters are group together to create something meaningful, these grouped letters become one item (or chunk), and allowing participants to memorize more letters with an ease.

Participants seemed to recall the first and last few letters. This can explained through the duration of short term memory. Participants tried repeat the first letters in their head. This causes them, busy repeating the first letters, to forget the letters in the middle. Also, participants remember last few letters, because they were the letters which were just told.

The methodology of the experiment was overall carried out well through. There were few drawbacks in the experiment. First, the history of the participants should have been dealt with. Some participants may not be aware of the materials presented, for example, the abbreviations. This could have been improved through pre-screening test. Second, the independent sample designing has a disadvantage, such as the difference between the groups; however, this experiment reduced this problem by randomly allocating the participants.

Conclusion

Having done the experiment, the outcome shows that short term memory is very limited to 7 plus minus 2 'chunks'. However, it is also very flexible; these chunks could be not only letters but words, numbers, or any meaningful items, allowing us to memorize more than 7 letters. I supported the research hypothesis; the number of recalled letters would be greater in 'chunked' letters group. The 'chunked' letters recalled far more (17.90) than 'unchunked' letters (7.23).

Reference

Books

Hugh Coolican. 1999. Tests at Interval/Ratio Level, Research Methods and Statistics in Psychology, London: Hodder & Stoughton, Second Edition.

William E. Glassman. 2000. The Cognitive Approach: Learning and Memory, Approaches to Psychology, Buckingham: Oxford Press, Third Edition

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Wikipedia – Short Term Memory. February 2008. February 29th 2008 <http://en.wikipedia.org/wiki/Short_term_memory>.

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Appendix

Table: Conditions A and B, number of words recalled and its average, dispersion, t-test values

Participants	Number of letters recalled		Difference (d) B score – A score	d^2
	Group A	Group B		
1	7	18	11	121
2	6	18	12	144
3	7	17	10	100
4	8	20	12	144
5	9	19	10	100
6	9	18	9	81
7	5	17	12	144
8	7	15	8	64
9	5	14	9	81
10	7	17	10	100
11	6	15	9	81
12	6	16	10	100
13	6	20	14	196
14	4	14	10	100
15	9	17	8	64
16	7	21	14	196
17	10	17	7	49
18	11	20	9	81
19	7	19	12	144
20	8	17	9	81
21	9	20	11	121
22	9	14	5	25
23	8	19	11	121
24	8	16	8	64
25	7	17	10	100
26	8	17	9	81
27	6	14	8	64
28	5	17	12	144
29	6	15	9	81
30	7	14	7	49

Working out of Significance (unrelated student t-test)

- ① First of all find the difference of number of letter recalled between 'unchunked' and 'chunked' conditions (d) for each participant.
- ② Calculate the sum of the differences ($\sum d$).
- ③ Square these differences (from (1)) for each participant.
- ④ Calculate the sum of the squared differences ($\sum d^2$).
- ⑤ Using the formula, calculate the t value.
- ⑥ Find the degree of freedom: number of participants – 2.
- ⑦ For $df=58$ and $p=.05$, the value is 1.672, our value is 7.32. Hence, the results were highly significant.

T-test Formula

$$t = \frac{\sum d}{\sqrt{\frac{(N \sum d^2 - [\sum d]^2)}{N-1}}}$$

N= number of participants

Sample Material

S
A
T
N
B
C
E
S
P
N
F
O
X
R
T
L
Q
U
I
Z
V
W
M
T
V

SAT

NBC

ESPN

FOX

RTL

QUIZ

VW

MTV

The letters were not presented in this order

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Informed Consent

The following will provide you with information about the experiment that will help you in deciding whether or not you wish to participate. If you agree to participate, please be aware that you are free to withdraw at any point throughout the duration of the experiment without any penalty.

This experiment will investigate the short term memory. The study will last about 15 minutes. The results from the study will be available to you and you only, and kept confidential. For any reason, if you want to withdraw from the experiment whenever, you are free to do so, and the results will be discarded. Furthermore you are free to ask the investigator any further question, please feel free to contact the investigator via e-mail or telephone.

I hereby agree to participate in the experiment and fully understand the procedures and my rights, by providing my signature below.

(signature of participant)

(name of investigator)

(print name)

All information will be kept confidential and your name will not be associated with any research findings.