

An experiment investigating the effect of concrete words and abstract words by using the dual code theory

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ABSTRACT

The study aimed to investigate which words, abstract or concrete, would be easier to recall. My hypothesis for the study was the mean recall of concrete words would be higher than abstract words among high school students. In order to conduct the experiment opportunity sampling and the repeated design was chosen. They were presented with 10 abstract words and then told to do the filler task. Furthermore, they had to write as many words they could recall from the words which were presented to them earlier on a sheet of paper. This same experiment would be conducted again with concrete words. The results indicated that concrete words were more recalled compared to abstract words. As the mean for concrete words were higher compared to abstract words. In conclusion, the results supported my hypothesis.

Keywords: *Experiment investigating, Concrete words, Abstract words, Dual code theory*

Cognitive psychology is one of the branches of psychology under which memory is one of the most complex mental processes which has been studied by cognitive psychologists. There has been a lot of investigation of how knowledge is being organized. This area has led many psychologists to conduct research on it and develop new theoretical explanation. One such theory is, the dual code theory by Allan Paivio (1971).

In 1971, Allan Paivio introduced the “Dual Coding Theory” (DCT). It is a cognitive theory which explains human behaviour and represent non-verbal and verbal information in related, separate systems. These processes work on a network of modality specific non-verbal (imagery) and verbal representations.

A study which was conducted by Paivio and Yuille in 1969 which supported the DCT. 96 participants were divided into two groups and one group was presented words in a syntactic manner, whereas the other, random. The participants were given a list of two learning and recall trials. Once they read all the words, they were given 4 minutes to write down as many words they could remember on the sheet of paper provided. The results supported the dual coding theory as the participants could recall more concrete words than abstract words. Abstract words refer to intangible ideas and concepts which makes it difficult to remember,

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Received: August 13, 2020; Revision Received: September 21, 2020; Accepted: September 24, 2020

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for instance, happiness or anger. However, concrete words are words that are tangible and can evoke mental images, which makes it easier to remember, for example, tree or box.

Richardson in 1974 conducted a study which indicated a limitation to Paivio's dual code theory, which also consisted of free recall of both concrete and abstract words. He found that the number of concrete words would only be recalled more if there was an interval between presenting the words and recalling the words. However, the significance was not that great in recalling from short term memory, which further explains that long term memory is where the effect of imagery lies.

In 1973, Anderson and Bower conducted an experiment where the main aim was to investigate if words that are tangible and can evoke mental images are easier to recall compared to words which are intangible ideas and concepts as it was predicted in Paivio's dual code theory. The results showed that verbal information with a visual picture helps a learner by making it much simpler, which occurs with concrete words. They also demonstrated that few verbal information is improved because of a similar or relevant stimulus which was provided to the participants.

This experiment is a variation of Anderson and Bower(1973). The aim of the study was to investigate which words, abstract or concrete, would be easier to recall. It will target students between the ages of 16-18 years old. It is important to study because it can be used as a learning strategy and benefit the upcoming generation to have a better understanding of the content they are studying. An addition of a filler task is in the experiment so that it can also test long term memory instead of short-term memory only. The participants were shown a list of abstract words and concrete words. A one - tailed hypothesis was chosen keeping the implications of the dual code theory in mind which stated that it is easier to recall words that evoke mental images compared to words that are concepts and difficult to understand and therefore it was expected that there would be a greater recall of concrete words compared to abstract words.

Hypothesis

H₁: The mean recall of concrete words would be higher than abstract words among high school students.

H₀: There will be no significant difference between recall of concrete words and abstract words. If so, it will be due to chance.

METHODOLOGY

Design

The design chosen for this experiment was repeated measures. However, this technique has some disadvantages too, for instance: boredom, tiredness and one of the major drawback is "order effect".

An informed consent form was given to the participants and were guaranteed that their confidentiality would be maintained and if they wished to they could withdraw from the experiment at any time. They were given instructions before the experiment and also debriefed after the experiment. The participants were not harmed psychologically or physically. Hence, all the ethical considerations were followed.

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Variable

Independent variable: If the words presented were abstract words or concrete words.

Dependent variable: The number of times the words (abstract or concrete words) were recalled from each of the two conditions.

Participants

The sample was taken from an IB school in Mumbai. The sample consisted of 18 participants with 11 males and 7 females between the age group of 16-18 years. This group was chosen since their first language is English, which is necessary to make sure that the participants understand the word in order to recall them. The sample population was founded using “opportunity sampling”, as it is the most convenient and economical. Additionally, using this type of sampling will help in data collection completing in a short time span and also it is common type of sampling which is used in experiments. Then, the participants would be randomly allocated by an online team maker which divided the participants into two groups aiding to eliminate sampling bias.

Materials

1. Materials needed: (add appendix to all)
2. List of ten abstract words
3. List of ten concrete words
4. Standardized instructions for briefing and debriefing
5. Blank sheet of papers
6. Pens
7. Two similar filler tasks (titled task 1)

Procedure

After the participants were ushered into the classroom, the researcher collected the consent forms, which was given beforehand. They were instructed to sit on any of the chairs available to them and not touch the papers and the pen given to them until asked to do so. Then the researcher read the standardised instructions (appendix 2) Then they were informed that the experiment has begun and then they were showed the set of ten words, each for 3 seconds. Then the participants were instructed to turn the paper and attempt the filler task for 2 minutes and try and complete as many sums as possible (in order to make sure that the words were stored in their long term memory). After 2 minutes the paper was collected and a blank sheet of paper was provided so that they could pen down how many ever words they could recall within 1 minute 30 seconds. Immediately the papers were taken from everyone and a new set of papers were provided to them. Then the same procedure was followed for the abstract words.

RESULTS

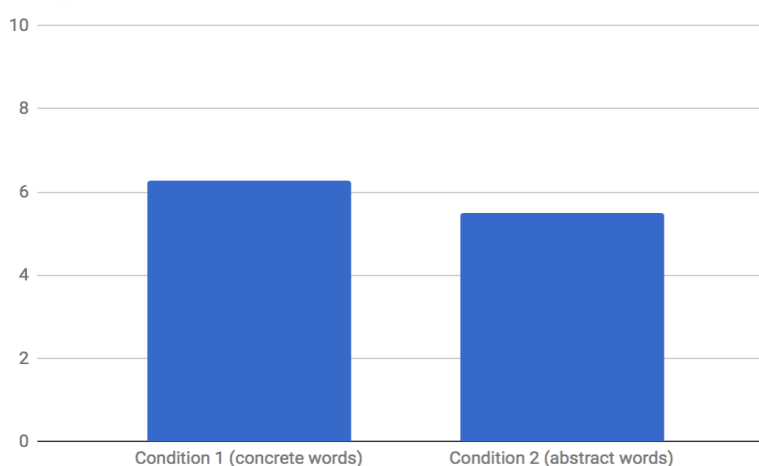
Descriptive

The standard deviation and mean were picked as descriptive statistics because interval data was collected in the experiment. Looking at the table below, it can be easily inferred that the mean amount of abstract words recalled (5.5) was lower than the mean of concrete words (6.27). The mean was dispersed close to the results of standard deviation (SD) being as low as 1.28 and 1.93. Due to the standard deviation being low, the results were consistent and not that spread out.

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	Mean	Standard deviation	N
Condition 1 (concrete words)	6.27	1.93	18
Condition 2 (abstract words)	5.50	1.28	18

Comparison of mean scores



Inferential

The test chosen for this experiment was the Wilcoxon test. It tested the difference in the experiment, the design chosen was repeated measure. However, there was a reduction to the original data by ranking as the data collected was interval. As Wilcoxon test was used, the critical value for one tailed hypothesis achieved was $P = 0.1357$ (appendix 6) and as it is smaller than $P \leq 0.05$. It indicates that there is no significant difference between the mean recall of words in both the groups.

DISCUSSION

Paivio's dual code theory concludes that as concrete words evoke a mental image it is easier to recall them compared to abstract words. In this investigation, the results have supported the theory as the difference ($P \leq 0.05$) between the number of times the words have been recalled by the participants in each condition is highly significant (6.27 and 5.50). A study conducted by Begg and Paivio in 1969 also showed the subjects could recall more concrete words compared to abstract words, which corroborated the results of their study to these findings.

In addition, conclusion made by Anderson and Bower (1973) about how verbal information can be improved for some memory. It will occur when the verbal information is easily imagined with a visual image by the learner. In our experiment the concrete words displayed could quickly create a mental image whereas abstract words could not. Furthermore, Begg and Paivio's (1969) study showed that meaning of concrete sentences stored highly in the forms of images compared to words. This explains that the change would be unnoticed and will not have any effect on the image represented, when the words of a concrete sentence

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have been changed but not the meaning. However, this experiment did not deal with complete phrases but instead just words, alike results were found as concrete words were recalled more easily, indicating that an image, which was evoked mentally was found effective as it stored the meaning of the words.

While conducting the experiment some limitations were made, for example, the briefing instructions, where the participants were explained that they had to recall the words presented to them after they were done with the filler task. Mostly because of the experimenter bias, few participants appeared to be disregard it and just focused on remembering the words which were presented to them. This was quite evident after the participants had done the first condition and now, they were convinced of the aim of the experiment. In order to avoid this experimental weakness, changes in the briefing instructions should be made by not mentioning about the filler tasks, so that the participants do not suspect the purpose of the experiment in the start itself. Nonetheless, “counterbalancing” is a significant methodological strength, which was utilised to prevent order-effects, in other terms should not have an impact on the reliability of the experiment to an extreme extent.

Keeping the aim of the experiment in mind, the filler task seems quite irrelevant, it questions whether it actually tested the LTM even a bit. Rather it might have tested the effect on STM. However, according to Richardson (1974), only imagery has an influence on recall from LTM. Hence, our findings indicated that imagery did not affect word recall and therefore it is quite evident that it did not test LTM.

Additionally, one more limitation could be that the experiment was conducted in the last period, which makes the participants really tired and the participants would get distracted easily as the position assigned to them was not that spaced out. A way to solve, this would be by conducting it in the morning when the participants are fresh and the concentration level would be high. Also, the findings cannot be generalisable to the entire population. Utilizing the Wilcoxon test a statistical data was calculated from which the results were obtained and were very crucial as it supported the hypothesis; hence supporting that concrete words are easier to recall as they evoke a mental image.

CONCLUSION

The aim of the experiment was successfully completed even though there were few limitations which can be taken care of in the future research. Furthermore, the hypothesis was supported in line with the previous research conducted in this area.

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Acknowledgments

The author appreciates all those who participated in the study and helped to facilitate the research process.

Conflict of Interest

The author declared no conflict of interest.

How to cite this article: Varma M. (2020). An experiment investigating the effect of concrete words and abstract words by using the dual code theory. *International Journal of Indian Psychology*, 8(3), 1321-1332. DIP:18.01.136/20200803, DOI:10.25215/0803.136

APPENDIX

Standardized briefing instructions:

Thank you for taking the time to participate in this experiment.

Please listen carefully to all the instructions and do not speak to the other participants

Please do not turn over the sheets in front of you until you are instructed to do so. Please note, if under any circumstances if you want to withdraw from the experiment, you can. If you have any questions please ask now.

Part 1: Ten words will be displayed to you, one by one for 3 seconds. Please pay careful attention to it.

Part 2: Each of you will be now be provided with the paper titled “task 1.” It contains a few mathematical problems. You have 2 minutes to complete this. Do you have any questions?

Part 3: Now on the blank sheet of paper provided to you recall the words which were shown and try to write as many words you can recall. You have 90 seconds to do this.

Part 4: Another set of words will be displayed and the same process will take place.

APPENDIX

Standardized Debriefing Instructions:

Thank you, for taking part in this experiment. The experiment is now finished. This was an Experimental investigation of dual code theory by using either abstract words or concrete words. Abstract words refer to intangible ideas and concepts. Concrete words are words that are tangible and can evoke mental images. Research has found that abstract words such as “kindness” are more difficult to visualise than a concrete word like “box”.

Additionally, if you want to know more about the experiment and wish to read the report once it is completed, please do let me know. Thank you once again.

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Words used as stimulus:

Abstract words	Concrete words
Friendship	Finger
Speed	Mirror
Sadness	Money
Knowledge	Seed
Life	Football
Hope	Wood
Pride	Brother
Intelligence	School
Empowerment	Beach
Happiness	Newspaper

APPENDIX

Task 1:

$$1060/7=$$

$$1_+_8=39$$

$$100^2=$$

$$60x2=$$

$$18+24=$$

$$18+_=3$$

$$2067/8=$$

$$635+256=$$

$$2885/3=$$

$$12x5=$$

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Task 2:

2304/9=

2_+_4=59

12^2=

9x8=

82-24=

24+__=4

50/25=

342+232=

49/7=

3^3=

APPENDIX

The raw data for concrete words

Participants	Scores	Mean scores	Square of mean squares
	X	X-X	(X - X)2
P1	6	0.277	0.0771
P2	6	0.277	0.0771
P3	6	0.277	0.0771
P4	9	-2.72	7.41
P5	3	3.27	10.7
P6	7	-0.722	0.521
P7	5	1.27	1.63
P8	5	1.27	1.63
P9	4	2.27	5.18
P10	6	0.277	0.0771
P11	3	3.27	10.7

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Participants	Scores	Mean scores	Square of mean squares
P12	9	-2.72	7.41
P13	5	1.27	1.63
P14	9	-2.72	7.41
P15	8	-1.72	2.96
P16	6	0.277	0.0771
P17	8	-1.72	2.96
P18	8	-1.72	2.96
	113	6.27	63.5

The raw data for abstract words

Participants	Scores	Mean scores	Square of mean squares
	\bar{X}	$\bar{X} - \bar{X}$	$(\bar{X} - \bar{X})^2$
P1	6	-0.5	0.25
P2	5	0.5	0.25
P3	7	-1.5	2.25
P4	5	0.5	0.25
P5	6	-0.5	0.25
P6	4	1.5	2.25
P7	9	-3.5	12.25
P8	5	0.5	0.25
P9	6	-0.5	0.25
P10	5	0.5	0.25
P11	7	-1.5	2.25
P12	5	0.5	0.25
P13	7	-1.5	2.25

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Participants	Scores	Mean scores	Square of mean squares
P14	4	1.5	2.25
P15	4	1.5	2.25
P16	5	0.5	0.25
P17	5	0.5	0.25
P18	4	1.5	2.25
	99	5.5	28

APPENDIX

The screenshot shows the VassarStats website interface. On the left is a navigation menu with categories like Utilities, Clinical Research Calculators, Probabilities, Distributions, Frequency Data, Proportions, Ordinal Data, Correlation & Regression, t-Tests & Procedures, ANOVA, ANCOVA, and Miscellanea. The main area contains a data entry table with columns for Pairs, X_a, X_b, S/R of |X_a-X_b|, Import/Export Box, and S/R = "signed rank". The table contains 18 rows of data. Below the table are input fields for W (43), n_{s/r} (16), and z (1.1), along with buttons for Reload, Reset, and Calculate. The calculated results show P(1-tail) = 0.1357 and P(2-tail) = 0.2713.

Pairs	Data Cells		S/R of X _a -X _b	Import/Export Box X _a and X _b	S/R = "signed rank"
	X _a	X _b			
1	6	6	---	6 6 ---	
2	6	5	+2.5	6 5 +2.5	
3	6	7	-2.5	6 7 -2.5	
4	9	5	+12.5	9 5 +12.5	
5	3	6	-8	3 6 -8	
6	7	4	+8	7 4 +8	
7	5	9	-12.5	5 9 -12.5	
8	5	5	---	5 5 ---	
9	4	6	-5.5	4 6 -5.5	
10	6	5	+2.5	6 5 +2.5	
11	3	7	-12.5	3 7 -12.5	
12	9	5	+12.5	9 5 +12.5	
13	5	7	-5.5	5 7 -5.5	
14	9	4	+16	9 4 +16	
15	8	4	+12.5	8 4 +12.5	
16	6	5	+2.5	6 5 +2.5	
17	8	5	+8	8 5 +8	
18	8	4	+12.5	8 4 +12.5	

W = 43
 n_{s/r} = 16
 z = 1.1
 P(1-tail) = 0.1357
 P(2-tail) = 0.2713

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VassarStats: Website for Statistical Computation

Utilities
 • Clinical Research Calculators
 • Probabilities
 • Distributions
 • Frequency Data
 • Proportions
 • Ordinal Data
 • Correlation & Regression
 • t-Tests & Procedures
 • ANOVA
 • ANCOVA
 • Miscellaneous
 • HOME

15	8	4	+12.5
16	6	5	+2.5
17	8	5	+8
18	8	4	+12.5

Reload W = 43
 Reset n_{s/r} = 16 P(1-tail) P(2-tail)
 Calculate z = 1.1 0.1357 0.2713

Critical Values of ±W for Small Samples

n _{s/r}	Level of Significance for a			
	Directional Test			
	.05	.025	.01	.005
Non-Directional Test				
n _{s/r}	--	.05	.02	.01
5	15	--	--	--
6	17	21	--	--
7	22	24	28	--
8	26	30	34	36
9	29	35	39	43

Please note that these small-sample critical values pertain to the version of the Wilcoxon test in which the test statistic, W, is calculated as the sum of all the signed ranks, positive and negative combined. Descriptions of this version of the Wilcoxon test can be found in Subchapter 12a of [Concepts and Applications of Inferential Statistics](#) and in Frederick Mosteller & Robert E. K. Rourke, *Sturdy Statistics: Nonparametrics and Order Statistics*, Addison-Wesley, 1973, 89ff.

[Home](#) Click this link **only** if you did not arrive here via the VassarStats main page.

Participants	Score of conditions 1 (concrete words) A	Score if conditions 2 (abstract words) B	Difference (A-B)
P1	6	6	0
P2	6	5	1
P3	6	7	-1
P4	9	5	4
P5	3	6	-3
P6	7	4	3
P7	5	9	-4
P8	5	5	0
P9	4	6	-2
P10	6	5	1
P11	3	7	-4
P12	9	5	4
P13	5	7	-2
P14	9	4	5
P15	8	4	4

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Participants	Score of conditions 1 (concrete words) A	Score if conditions 2 (abstract words) B	Difference (A-B)
P16	6	5	1
P17	8	5	3
P18	8	4	4