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## Levels of Processing

Dipal Patel<sup>1</sup>

### ABSTRACT:

The aim of this experiment was to investigate the impact of levels of processing (Independent Variable) on our memory (Dependent Variable). We hypothesized to find that a deeper level of processing lead to a better memory and in turn, greater recall. The experiment controlled variables such as environmental conditions, age of the target population and educational background of the participants. The experiment uses the Independent Measures design and the participants are a convenience sample of teenagers. We reduced Practice Effect and Fatigue Effect by using the Single-Blind Technique. The results proved the hypothesis: Semantic encoding lead to greater retention and a deeper trace of memory whereas Structural encoding lead to a shallow processing of memory. These results are replicated in Craik and Lockhart's (1972), Levels of Processing model. The researches done by Hyde and Jenkins (1973) and Craik and Tulving (1975) also prove the same results: deeper levels of processing lead to better recall. The Mann-Whitney U test also made a clear distinction in the number of words recalled due to deep and shallow processing. The study also raised some limitations such as generalizations, rehearsal, ecological validity and others. In totality, the experiment effectively manipulated variables and reproduced accurate results.

**Keywords:** *Processing, memory*

**Research Question:** To what extent do levels of processing influence memory of words?

Learning occurs through many different processes. The Levels of Processing are used to explain why we have a deeper trace of some things and a shallow trace of the others.

The research by **Craik and Lockhart** (1972) on levels of processing serves as a backbone for cognitive psychology. In contradiction to the Multi-Store Model by *Atkinson and Shiffrin* (1968) that divides memory into different stores (STM and LTM), the levels of processing model by Craik and Lockhart suggests that memory occurs through different processes.

Shallow Processing is divided into Structural (visually appealing words) and Phonological (sound words) encoding whereas, Deep Processing is based on Semantic (meaning of words) encoding. They proved through their research that “trace persistence is a positive function of the depth to which stimulus has been analyzed” which means, *Elaborative Rehearsal* (analyzing the words) lasts longer than *Distinctiveness* (distinguishing between words).

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<sup>1</sup>PhD, Student, M.S.University, Baroda

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Another research by **Craik and Tulving** (1975) is similar and furthermore validates the former research. They conducted an experiment where the participants were divided into 3 groups. Each participant was given a list of 60 words through one of the three tasks, which tested the three levels of processing. The memory recognition test concluded that the words semantically processed had a greater recall than the rest.

**Hyde and Jenkins** (1973) also carried out an experiment using the *incidental learning* (informal learning) technique. They divided their participants into different groups and conducted one of five tasks on each. After the surprise recall test, they concluded that those tasks, which involved semantic processing, had a better recall and in turn deeper processing.

**Elias and Perfetti** (1973) performed a study using the same technique. It involved a rhyming task for a list of words along with finding synonyms for the same. Participants in the synonym task were able to recall more words than the rest, drawing the same conclusion as above.

Hence, It was chosen to investigate the relationship between levels of processing and the recall of words by conducting two asks: One in which the first group of participants need to identify the word color and the other in which the second group needs to make sentences with the given words.

## HYPOTHESES

**Null Hypothesis:** There will be no influence of the levels of processing on memorizing words.

**Non-directional Hypothesis:** There will be a significant difference in the recall of words semantically processed to those structurally processed.

**Directional Hypothesis:** The number of words semantically processed will leave a deeper trace than those structurally processed.

## METHOD

### Design

The participants were given a Consent Form and were not forced to be a part of the investigation. They were given clear instructions at the beginning of the task and debriefed at the end.

### Independent Variable:

Deep and Shallow Levels of Processing

### Dependent Variable:

Number of words recalled

### Control Variables:

Environmental Conditions

Age of the student

Educational level of the student

Number of words

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Demand Characteristics was reduced by using the Single Blind technique as there was a conduction of a surprise recall test at the end of the task before which the participants were not allowed to interact with each other. It was also mentioned in the consent form that their identity will remain hidden. Hence, this reduced the Fatigue Effect and Practice Effect.

Independent Measures was used in our design as each participant was part of either group and were allowed to perform either one of the tasks involving deep or shallow levels of processing. Therefore, this increased External Validity.

The Mann-Whitney U Test was conducted as it is a non-parametric test and the sample participating in the research does not exceed thirty, hence it proved as a suitable calculation test representing statistical data for our test.

### Participants

Non-Probability Sampling was used under which Accidental Sampling or Convenience Sampling was used keeping the age group constant. It was also the most convenient for an experiment to be carried out in a school setting.

The experiment was conducted on 20 participants in total, and they were divided into two groups of 10 participants. In consideration of gender, the participants were randomly mixed and each group consisted of an uneven number of males and females.

The target population included 16-year-old children having a similar educational level and a part of International Board Year-1. As a control, the participants in Group 1 (Deep LOP) completed the task together at the same time and participants in Group 2 (Shallow LOP) did the same. This reduced the chances of interaction between participants.

### Materials

- Pen
- Stopwatch
- Appendix A- Consent Form
- Appendix B- Parents Consent Form
- Appendix C- Standardized Instructions
- Appendix D- Word lists and attached Task sheets
- Appendix F- Debriefing Letter
- Blank sheets of paper

A classroom setting was required to conduct the experiment.

### Procedure

The procedure was identical for both groups, Group 1 (Deep LOP) went first and then followed by Group 2 (Shallow LOP)

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The participants were not allowed to interact at any point during this experiment.

- Each group was taken to a comfortable classroom with sufficient chairs and tables for 10 participants.
- They were then handed the Consent Form (Appendix A) and Parent's Consent Form (Appendix B) for those above the age of 16.
- Thereafter, the Standardized Instructions (Appendix C) for each group respectively, was handed out. The participants were allowed to withdraw at this point. For those who did not clearly understand, the instructions were explained individually.
- They were then given the Word lists and Task sheets (Appendix D) but were not allowed to begin until told.

Group	Time Limit	Task
Group A (Deep LOP)	8 minutes	Make sentences with the given words.
Group B (Shallow LOP)	2.5 minutes	Identify the color of the letters of each word and write how many were blue, green and red in the given blanks.

- The time limit was maintained using a stopwatch and after the time was up, the participants were asked to keep their pens down while we began collecting the answer sheets. If a participant completed early, the rest of the time was used to revise and recheck their answers.
- Then after, we announced the surprise recall test and a blank sheet of paper was given out to each participant.
- They were given 1 minute to complete their recall test and the time was kept using a stopwatch.
- The answer sheets were collected after the completion of this task and they were asked to maintain silence until they left.
- The Debriefing letter (Appendix F) was then handed out. After it was read, we collected it and the participants of this group were asked to remain seated until we gathered the next group into another classroom.

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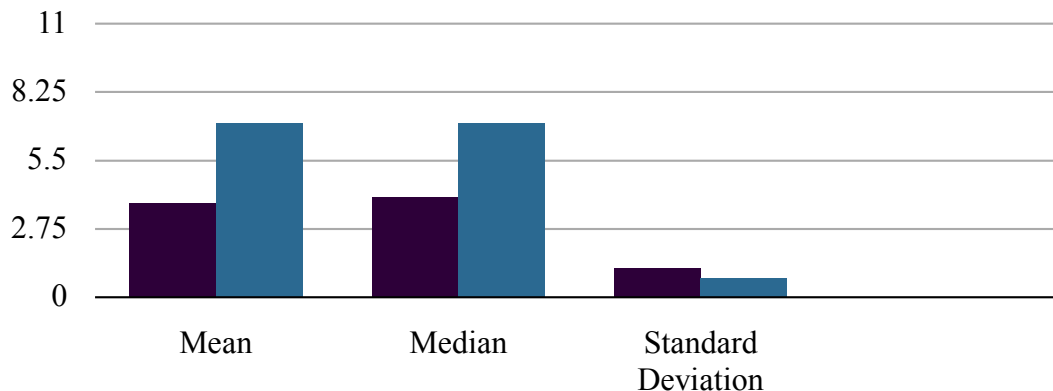
### RESULTS

	Group A (Deep LOP)	Group B (Shallow LOP)
Mean	7	3.8
Median	7	4
Mode	7	3,4 (Bimodal)
Range	4	2
Standard Deviation	0.748	1.154

### DISCUSSION

The aim of the experiment was; to what extent do levels of processing affect our memory of words. This was proved by the results of our investigation as the participants who made a meaningful sentence with the words had a deeper level of processing compared to those who merely skimmed through the words by identifying the color of the letters.

This study reproduced the same results as that of **Craik and Lockhart** (1972). The variables were the same for all the researches mentioned in the Introduction (Pg. 4). The experiment conducted by **Craik and Tulving** (1975) reinforced that the depth of processing increases as you go further from Structural processing to Phonological and the deepest at Semantic processing.



■ Shallow LOP ■ Deep LOP

Our research tested only two of these conditions, the Structural encoding was the task where the colors of the letters were required to be identified and this proved to be a Shallow level of processing. The second task required the participants to make sentences with the same word list,

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with this the words were processed deeper in the brain. The cognitive function of memory is affected by many conditions such as these. The research by **Hyde and Jenkins** (1973) also proved the same hypothesis with 3 added tasks in comparison to our experiment. They also concluded that more words were recalled as a result of Semantic processing.

The statistical results also proved the same; the mean, median and mode for Group A was a greater number compared to Group B showing a greater number of words recalled due to deeper processing. According to Craik and Lockhart, 'memory is a by-product of perception' and if words in our brain are perceived deeper, our memory is stronger in the long term. The results also replicated that of Craig and Tulving's experiment as they proved the same with the help of their analysis. Hyde and Jenkins conducted a wider, in depth analysis reproducing that the recall is directly proportional to the depth of processing. We also incorporated incidental learning in our test; with the help of a surprise recall test and Convenience Sampling.

By using the same classroom setting in both the cases, we made sure that the participants are not only comfortable but also in an appropriate condition to answer the task. With this the environmental conditions were controlled. The age of our target population was the same, and all the children were from the same grade. This kept the age and educational background of the participants constant. The independent measures design ensured the elimination of the Practice Effect and Fatigue Effect. The Single-blind technique also ensured that Demand Characteristics were avoided.

Our participants were given a Consent form (Appendix A) before the investigation and were thanked and debriefed at the end (Appendix F). They were allowed to withdraw at any point during the experiment was being conducted. Their anonymity was protected even after we released the results, which they chose to view or obtain. The experimenters were also conscious not to disrupt the participants in any way, which would hinder their completion of the test and in turn the results.

A laboratory experiment like this one questioned ecological validity as the variables could have had an impact on the responses in participants. We also avoided taking the task sheet before the entire group completed the experiment and this may have resulted in rehearsal, affecting our analysis to an extent. The direct comparison of the results between the two groups might have also created some uncertainties as the participants were different and their cultural and social background could have impacted. As we have studied, cultural and social factors affect our memory and one tends to remember things they can relate to. Some words might have evoked this resulting in inaccuracies.

It can be very difficult to make generalizations by using Opportunity Sampling, as it may not have met the exact requirements for the target population. Random Sampling could have been a better options but it is more widely distributed and therefore time consuming.

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There was a conflict between concrete and abstract words affecting the recall of a participant. As suggested by **Walker, I., & Hulme, C.** (1999), concrete words (objects/events that avail to our senses) are recalled more than abstract words (an idea/concept). To avoid this, the word list could have included either one of those sets. Another study by **Weldon, M.S., & Bellinger, K.D.** (1997) concluded that words learnt collaboratively are leaving a deeper trace in the memory compared to individual processes in remembering. This contradicts our research as the task was given to one participant, separately. To avoid this, the test could have been carried out collectively, in order to compare the results.

The difficulty of words was maintained to a minimum but this cannot be judged, as a participant might have been familiar with some and not with the others. To avoid this, we could have consulted the word list to a control group and an English teacher.

In conclusion, this experiment effectively manipulated variables and obtained accurate results to prove the hypothesis. The deeper level of processing (Semantic encoding) leaves a deeper trace of memory, resulting in a better recall. These results support the Levels of Processing theory by Craik and Lockhart (1972).

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### APPENDIX A

#### Consent Form

The participant is required to agree to the conditions mentioned below and thereby give his/her informed consent to participating in the research.

I have been briefed about the research and assured that I will not be harmed in any way. I have the right to withdraw from the experiment at any point of time and am under no obligation to participate. My anonymity will be protected.

The research will be conducted so that I will not be debased in any way.

Please place a  $\surd$  or  $\times$  in the following boxes:

I would like the results of my test to remain confidential

I would like more information about the results later on

Name (optional): \_\_\_\_\_

Date: \_\_\_\_\_

E-mail: \_\_\_\_\_

Age: \_\_\_\_\_

### APPENDIX B

#### Parent's Consent Form

To the concerned parent,

I am a PhD student, from the Department of Psychology. M.S.University, Baroda. I have performed a harmless experiment concerning the levels of processing in your child and his/her classmates.

As your child is under the age of sixteen I would require your consent to use his/her results from the test in preparing our report for the psychology internal assessment. The participants have been asked to fill out a questionnaire regarding the shallow/deep levels of processing according to their previously known knowledge. You are permitted to ask any further questions regarding this experiment. Your child will remain anonymous and this experiment will not harm him/her in any way.

Thank You

Participants' name: \_\_\_\_\_

Signature of parent: \_\_\_\_\_

Date: \_\_\_\_\_



## APPENDIX C

### Standardized Instructions

#### Group A (Deep LOP)

We will be performing a short experiment, with your consent, on levels of processing.

The experiment has only one component and after reading the instructions below, a questionnaire will be handed to you which, needs to be filled in as follows:

You will be given a list of words. Beside each word, there is a blank space, where you will be required to form a sentence using each of the words.

e.g. Cat - My cat sleeps all day long.

You will be timed for this section. During this time you are not allowed to communicate with anybody. You are permitted to re-check your answers before submitting them. Please notify the researcher if you wish to withdraw from the research at any time.

After the test has been completed, i would appreciate your time to fill in our feedback form.

Thank you.

#### Group B (Shallow LOP)

A short experiment will be performed, with your consent, on levels of processing.

The experiment has only one component and after reading the instructions below, a questionnaire will be handed to you which, needs to be filled in as follows:

You will be given a list of words. Write the number of letters in each word under each of the colored columns. e.g. Psychology = Red- 5 Blue- 3 Green-2

You will be timed for this section. During this time you are not allowed to communicate with anybody. You are permitted to re-check your answers before submitting them. Please notify the researcher if you wish to withdraw from the research at any time.

After the test has been completed, the researcher will appreciate your time to fill in our feedback form.

Thank you.

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Appendix D

Word List and Task Sheet

Group A (Deep LOP)

Amoeba- \_\_\_\_\_

\_\_\_\_\_

Stall - \_\_\_\_\_

\_\_\_\_\_

Believe - \_\_\_\_\_

\_\_\_\_\_

Amount - \_\_\_\_\_

\_\_\_\_\_

Peon - \_\_\_\_\_

\_\_\_\_\_

Tongue - \_\_\_\_\_

\_\_\_\_\_

Bully - \_\_\_\_\_

\_\_\_\_\_

Whether - \_\_\_\_\_

\_\_\_\_\_

Aggression- \_\_\_\_\_

\_\_\_\_\_

Dictionary - \_\_\_\_\_

\_\_\_\_\_

Google - \_\_\_\_\_

\_\_\_\_\_

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Tomorrow - \_\_\_\_\_  
\_\_\_\_\_

Catastrophe - \_\_\_\_\_  
\_\_\_\_\_

Mobile - \_\_\_\_\_  
\_\_\_\_\_

Baseball - \_\_\_\_\_  
\_\_\_\_\_

### Group B

(Shallow LOP)

	Red	Blue	Green
Amoeba	_____	_____	_____
Stall	_____	_____	_____
Believe	_____	_____	_____
Amount	_____	_____	_____
Peon	_____	_____	_____
Tongue	_____	_____	_____
Bully	_____	_____	_____
Whether	_____	_____	_____
Aggression	_____	_____	_____
Dictionary	_____	_____	_____
Google	_____	_____	_____
Tomorrow	_____	_____	_____
Catastrophe	_____	_____	_____
Mobile	_____	_____	_____
Baseball	_____	_____	_____

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### Appendix E

Descriptive Statistics

Group A (Deep LOP)

**Mean:** Total number of words recalled/ Number of participants =  
 $7+7+7+7+10+7+6+7+6+6/10 = 7$

**Median:**  $7+7/2 = 7$

**Mode:** 7

**Range:**  $10-6 = 4$

**Standard Deviation:**

Participants	X (Scores)	X <sup>2</sup>
1	7	49
2	7	49
3	7	49
4	7	49
5	10	100
6	7	49
7	6	36
8	7	49
9	6	36
10	6	36
	Total = 70	Total = 502

**Standard Deviation = 0.748**

Descriptive Statistics

Group B (Shallow LOP)

**Mean:** Total number of words recalled/ Number of participants =  
 $4+3+3+4+5+4+4+3+5+3 = 3.8$

**Median:**  $4+4/2 = 4$

**Mode:** 3,4 (Bimodal)

**Range:**  $5-3 = 2$

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### Standard Deviation:

Participants	X (Scores)	X <sup>2</sup>
1	4	16
2	3	9
3	3	9
4	4	16
5	5	25
6	4	16
7	4	16
8	3	9
9	5	25
10	3	9
	Total: 38	Total: 150

**Standard Deviation = 1.154**

### Appendix E

Inferential Statistics

Mann-Whitney U Test

$$U = n_1 n_2 + \frac{n_2(n_2+1)}{2} - \sum_{i=n_2+1}^{n_2} R_i$$

$R_i$  = Rank of sample size

$n_1$  = Sample (1)

$n_2$  = Sample (2)

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Group A (Deep LOP)	Points	Group B (Shallow LOP)	Points
7	100	4	0
7	100	3	0
7	100	3	0
7	100	4	0
10	100	5	0
7	100	4	0
6	100	4	0
7	100	3	0
6	100	5	0
6	100	3	0

**Total = 100**

**Total = 0**

**Lower Value = *U***

#### **Appendix F**

Debriefing Letter

Thank you for participating in this research. The aim of the experiment was to investigate the difference between Shallow and Deep Levels of Processing. The researcher divided the sample in to two different groups. Group A was given a list of words in which they were required to identify the number of letters colored in the word. Group B was given a list of words with which they were required to form sentences. The list of words for both the groups was the same and both had to recall the maximum number of words they remembered.

Hypothesis was that Group A would recall more words than Group B because they had a deeper level of processing whereas the latter merely glanced through the words. All the results of the study will be made available to you once they are finalized. If interested in viewing the results, please contact me on my email id: “dipalsdpate19@gmail.com”

Thanking You,

Dipal Patel.

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## ACKNOWLEDGEMENT

It has been an enriching experience on the way (especially, the last couple of days had seemed to have imperceptibly merge on one another), as much of an intellectual enterprise as one of soul stirring courses moments of hope and restlessness.

With this exercise nearing a meaningful end, I like to thank my source of inspiration, Prof. R. G. Kothari, Dean, Faculty of Education and Psychology, M. S. University. Baroda.

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Before winding up, I thank all the students who participated in the study for their cooperation and patience. Without their contribution the research would not have been completed.