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Title

An experiment to investigation the effect of sorting words by their meaning and sorting words by their font style on the number of words correctly recalled.

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Abstract

This investigation is based on Craik and Tulvig's research (1975) into Craik and Lockhart's (1972) "Levels of Processing" theory. They asked participants questions about either the meaning, sound of appearance of a list of 60 words and they found that participants correctly recognised more of the words in the 'meaning' condition than in the 'sound' or 'appearance' condition put together.

The aim of this study was to investigate whether words sorted by their meaning are better recalled, than the same words sorted by their appearance. The experimental hypothesis was "The participants who sort the words according to the meaning of the word will recall significantly more words than the participants who sort the words according to font style."

The research method chosen was a field experiment using an independent groups design, where one group had to sort the words by their meaning and the other group had to sort the words by their font style. The target population was Y9 King Ecgbert School students in Sheffield, they were selected by opportunity sampling, and there were 10 participants in each group.

Participants who sorted the words according to the font -style correctly recalled a mean number of 1.9 words, whereas the participants who sorted the words according to their meaning correctly recalled a mean number of 8.2.

The experimental hypothesis was accepted and the researcher concluded that the amount of information correctly recalled can be increased if the level at which the information is processed is increased.

Introduction

When trying to learn a specific piece of information teachers always discourage students from copying the information out of a textbook because it is possible for the student to read the text and write down the information 'word perfect' and still not know what the text is about. Whereas, when a student reads the text and then writes it down in his/her own words they have to understand the information, and therefore, they are far more likely to remember it because they link it to information, which has

been previously stored in their long-term memory and so are processing it at a deeper level. In psychology, this is known as the levels of processing.
However, it may be argued that the student who re-writes the information in the textbook simply spends longer looking at the information than the student who copies the information straight out of the book so this is why they remember more of the information.
In 1972, Craik and Lockhart formed the levels of processing theory. They insisted that the processing of information affects later recall of the information, and that a deeper level of processing leads to better recall of the information. Craik and Tulving (1975) tested the levels of processing theory by investigating the effects of different levels of processing on the recall of words. Craik and Tulving showed participants a list of 60 words, each of which they had to answer one of three questions about. The question was either about the case of the word (whether it was written in capitals or lower case-structure/appearance), a question the sound of the word (whether it rhymed with another word or not-phonetics), or a question about the meaning of the word (whether it fit into a sentence or not-semantics). Questions were given orally along with a visual image of the word then participants had to answer the question. Participants were then given a surprise recognition test, where they were shown a list of 180 words and had to identify as many of the 60 words they had been asked questions about, as possible. Craik and Tulving found that 17% of the words in the appearance condition (shallow processing) were correctly recognised, 37% of the words in the phonetics condition (mid-processing) and 65% of the words in the semantics condition (deep processing). This experiment was conducted to support Craik and Lockhart's (1972) theory that the level of processing has a significant effect on how memorable the information is.
This research is investigating the levels of processing. The aim of this experiment is to investigate whether words sorted by their meaning (semantics) are better recalled, than the same words sorted by their appearance (structure), when there is no specific instruction to learn the words (and participants are not previously told they will have to recall the words).
The experimental hypothesis to be tested is one-tailed based on the results of previous experiments:

"The participants who sort the words according to the meaning of the word (semantically) will recall significantly more words than the participants who sort the words according to font style (appearance/structure)."

The null hypothesis is:

"There will be no significant difference in the number of words recalled between the participants who sort the words according to their font style and the participants who sort the words according to their meaning".

Method

Design

The research method chosen was a field experiment because the researcher wanted to test the participants in their natural environment to make them feel relaxed and act more naturally to increase the ecological validity of the experiment.

The experimental design chosen was the independent groups design because the researcher was investigating the effects of two different levels of processing on the same words, on the recall of these words. The first condition was where the participants had to sort the words by the font style and the second condition was where the participants had to sort the words by the meaning of the word. If the same participants had been used in both conditions then they would be more likely to recall more words in the second condition because they would remember them from the first condition.

The independent variable of the investigation was whether the participants had to sort the words by the font style that they were typed in or by the meaning of the word. Participants were randomly allocated to the two conditions by getting each participant to choose one of two folded pieces of paper. One piece of paper had the number 1 typed on it, allocating the participant to condition 1, which was to sort the words by the font style and the other piece of paper had the number 2 typed on it, allocating the participant to condition 2, which was to sort the words by the meaning of the word.

The dependant variable was the number of words that were correctly recalled by the participants.

One extraneous variable to be controlled was the amount of time that the participants had to sort the words into four groups. If some of the participants had been given longer to sort the words than others then they may recall more of the words simply

because they had seen them for a longer amount of time and not because they had processed the words more deeply. Therefore, all participants need to be given the same amount of time to individually sort the words so they were all given a time limit of 60 seconds.

Another extraneous variable to be controlled was the amount of time that the participants were given to recall the words. If some of the participants had been given longer to recall the words than others they may recall more of the words simply because they had a longer time to try to remember them. Therefore, all participants need to be given the same amount of time to recall the words so they were all given a time limit of 30 seconds.

Participants

The target population for the experiment was Y9 King Ecgbert School students in Sheffield.

The participants were selected by opportunity sampling because this was the quickest and most convenient method of getting a c lass of Y9s. Once the researcher had selected the Y9 class the participants were then able to volunteer to participate in the experiment and this was beneficial to the researcher because the participants were less likely to withdraw from the experiment because they were willing and had volunteered themselves.

There were 10 participants in each group.

Materials and Apparatus

- The researcher typed “1” on one piece of paper and “2” on another and folded the up so that the participants had a fair chance of picking either pie ce of paper and so randomly allocating themselves to the condition corresponding with the number typed on the piece of paper.
- A set of 20 cards were made on the computer by the researcher. The cards were designed so that each one had a different word typed on it and they were all written in black text, size 18 so that the words were clear and there was no chance of participant mistaking handwriting. 5 of the 20 words were written in font Bauhaus 93, 5 in Curlz MT, 5 in Lucida Handwriting, and the other 5 in Poor Richard, for the participants in condition 1 to sort the words by font style.

5 of the words were fruits, 5 cities, 5 occupations and the other 5 colours, for the participants in condition 2 to sort the words by the meaning of the word. I decided to use these specific words because they are all common words that I felt would be familiar to the students and so decrease the risk of participants not being able to recall words because they did not know them.

- A stop-clock was used by the researcher in order to accurately keep time limits on the participants sorting and recall times.
- 20 pieces of lined paper and pens were used for the participants to record the words that they could recall. On 10 of these pieces of paper the researcher had written the number "1", to give to the participants in condition 1 and on the other 10 pieces of paper the researcher had written the number "2", to give to the participants in condition 2.

The 20 words and the pieces of paper with "1" and "2" on are available in the appendix.

Task

The basic task of the experiment was for the participants to sort a set of 20 words into four categories, each category containing five words, in 60 seconds. Participants in condition 1 had to sort the words by font style and participants in condition 2 had to sort the words by meaning of the word. Participants then had to count to 30 in twos as a distracter task so that they could not rehearse any of the words and would not remember the last words they had seen. Then participants had a free recall task where they had to recall as many of the words as possible in any order, within 30 seconds.

Procedure

The researcher had previously spoken to the Y9 class teacher about the psychology experiment they wanted to conduct on the students and asked for their consent to carry out the experiment on their class. When the participants entered the classroom, the teacher introduced the researcher to them. The researcher read the brief aloud to the class and collected volunteers.

In the corridor, outside of the classroom the researcher had set up a small desk with two chairs either side of the desk, on the desk was a stop -clock, the set of 20 words and the pieces of paper for random allocation to either condition 1 or 2.
The researcher sat in one of the chairs and the teacher sent the first participant out of the classroom to take part in the experiment with the researcher in the quiet corridor. The researcher placed paper 1 in one hand and paper 2 in the other then asked the participant to 'pick a hand', which allocated the participant to either condition 1 or condition 2.
The researcher then read out the standard instructions according to whether the participant had been allocated to group 1 or group 2. Then the researcher collected in the participant's answer sheet, thanked them for taking part in the experiment and let them return to the classroom.
The next participant was called in, and this method was repeated until the researcher had collected results from all 20 volunteer participants.
After all the participants had been tested, the researcher returned to, the classroom and read debriefed all the participants. The teacher of the class reviewed the experiment and completed a consent form.
The brief, standardised instructions, debrief and teacher consent form can be found in the appendix.

Ethical Issues

One ethical issue raised by the research was that it was conducted on participants under 16 and therefore they were below the age of which they could give their informed consent, however the researcher got the consent from both the student's head teacher and class teacher to carry out the experiment.
In addition, the brief deliberately deceived the participants, in that the aim of the experiment was kept from them until the debrief and the brief did not contai n any information on the free-recall test that the participants were later asked to take part in. This is because, if the participants had known about the free -recall test and the aim of the experiment beforehand then the researcher would have collected re sults measuring the participants memory/rehearsal skills and not the effects of the levels of processing on the words. In effect, the participants did not give their consent to the entire experiment so they were fully debriefed and reminded of their right to withdraw from the experiment.

The participants were not exposed to any harm and all their data was kept confidential.

Results

A table to show the mean, mode, median (measures of central tendency) and range (dispersion) of the number of words correctly recalled by participants who had sorted the words by font-style and participants who had sorted the words by meaning.

	Number of words recalled	
	Words sorted by style of font (Group 1)	**Words sorted by meaning of the word (Group 2)**
Mean	1.9	8.2
Mode	1	7
Median	1.5	7.5

The calculations can be found in the appendix.

Summary of the data

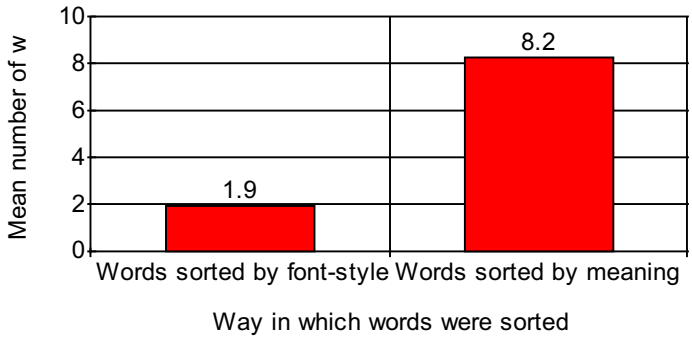
The results show that participants who sorted the words according to the font -style correctly recalled a mean number of 1.9 words, whereas the participants who sorted the words according to their meaning correctly recalled a mean number of 8.2. Therefore, participants who sorted the words by their meaning correctly recalled a mean number of 6.3 more words than the participants who sorted the words by the font-style.

Overall, the (modal number) most frequent number of words to be correctly recalled by participants who sorted the words according to the font -style was 1, whereas the most frequent number of words to be correctly recalled by participants who sorted the words according to their meaning was 7.

The middle value (median) of words correctly recalled by participants who sorted the words according to the font-style was 1.5, whereas the most frequent number of words to be correctly recalled by participants who sorted the words according to their meaning was 7.5.

The following bar chart further illustrates these findings, relating to the mean number of words correctly recalled

A bar chart to compare the mean number of words correctly recalled by participants who had sorted the words by font-style and participants who had sorted the words by their meaning.



Discussion

The results support the experimental hypothesis that "the participants who sort the words according to the meaning of the word (semantically) will recall significantly more words than the participants who sort the words according to font style (appearance/structure)". The mean number of words recalled (out of 20 words) by participants who sorted the words by their meaning was 8.2 whereas the mean number of words correctly recalled (out of 20 words) by participants who sorted the words according to their font style was 1.9. Therefore, the experimental hypothesis is accepted and the null hypothesis is rejected.

The results of this experiment support Craik and Lockhart's (1972) "Levels of Processing" theory, because they insisted that the level of processing affects later recall of the information, and that a deeper level of processing leads to better recall of the information. In this experiment the words sorted by meaning had been 'deeply processed' because participants had to think about their semantics in relation to the

other words, so the information was strengthened in the memory. However, the words sorted by the style of writing had been 'shallowly processed' because participants only had to look at the way the words appeared on the cards so fewer words were recalled. This experiment was similar to that of Craik and Tulvig's (1975), since its aim was to investigate the levels of processing and participants processed words related to their meaning and related to their appearance. However, the words in Craik and Tulvig's experiment were read aloud to the participants *and* shown to them, and participants were asked questions about the words instead of being asked to sort them into groups. In addition, instead of being given a free recall test, participants were given a recognition test, where they had to remember which 60 out of the 180 they had been tested on and participants were also asked questions about the phonetics of some of the words, which was supposed to be a middle level of processing.

One limitation of this experiment was that the participants were selected through opportunity sampling so the participants were not a very good representative sample of the entire population and researcher bias could have had an influence (e.g. the researcher could have selected participants that they thought would provide them with the best results). To improve the experiment the researcher could use quota sampling by researching the percentage of males and females in the target population and then select a sample of participants for the experiment that contains the number of males and females that is proportional to the target population. This would mean the sample better represents the entire population.

An idea for further research would be to ask half of the participants to place the words into complex sentences e.g. "Any good (Photographer) will tell that in order to capture the perfect photograph you need to have good lighting". And to ask the other half of the participants to place the words into simple sentences e.g. A "Photographer" takes photographs, to investigate whether further increasing the depth of processing, further increases the number of words recalled. This will make the experiment more realistic, since students are more likely to read and write sentences, rather than simply sorting words, so this will increase the ecological validity.

In everyday life, we often have to process information that we need to remember later, and we often remember this information if it *means* something to us. Therefore, the results of this experiment do relate to real life because we often try to remember

information by linking it with information that we already know. However, we must remember that we can forget information, even if we believe that it has been deeply processed because it is simply not immediately accessible for recall.

Conclusion

This experiment shows that information that we process deeply is better stored in the memory and so more likely to be remembered correctly, than information that is processed shallowly. This is known as the Levels of Processing, (Craik and Lockhart, 1972).

References

Eysenck, M. W. (1984) A Handbook of Cognitive Psychology. Hillside Lawrence Erlbaum, Associates.

Pennington, D. (2002) Introducing Psychology; Approaches Topics and Methods. Hodder & Stoughton

Appendices

Appendix 1- Head and Class teachers' consent form.

Appendix 2- Brief, Standardised Instructions, and Debrief.

Appendix 3- The 20 words and the pieces of paper with "1" and "2" on.

Appendix 4-Participants' response sheets.

Appendix 5- Raw data analysis.

Appendix 1

King Ecgbert School

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TECHNOLOGY COLLEGES

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Head Teacher's Consent

As head teacher of King Egcbert School, Sheffield, I give my consent for pupils under the age of 16, to take part in the research carried out by the psychology AS/A level students from King Ecgbert School. I authorise the psychology teachers in charge of the Psychology AS/A level course to check the research for ethical objections.

Each student wishing to conduct a psychology project using pupils under the age of 16 must get written consent from the class teacher in charge of the children. Any class teacher who is unhappy about what is required from the pupils has the right to refuse consent. The pupils must also be given the choice to take part in the study and to withdraw at any time.

Head teacher: [signature] Date: 1/11/06

Class Teacher's Consent

I have read the brief regarding this research project. I can see no ethical objection to the pupils in my class taking part in the investigation if they agree to do so.
I can confirm that the student carrying out this investigation has;

- [x] Briefed the pupils as to what they will be asked to do
- [x] Asked the pupils if they wish to take part
- [x] Told the pupils that their results will be anonymous
- [x] Informed the pupils of their right to withdraw
- [x] Debriefed the pupils fully including explaining any deception that may have been used and giving the pupils the right to withdraw their results if they wish
- [x] Answered any questions asked by the pupils.

Class teacher: [signature] Date: 21 FEB '07

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Appendix 2

Brief

I am carrying out a psychology experiment to research different levels of processing information and I was wondering if you would like to take part.
You would be given a set of 20 cards, each with a different word on then you would have 30 seconds to sort the cards according to the topic I give you; into four categories (each category containing 5 cards).
You will remain anonymous and if for some reason, you do not wish to continue with the experiment you are free to withdraw at any time and any data I have collected from you will not be used.

Standardised Instructions

Pick a hand- *holding out each hand, one containing paper 1 and one containing paper 2.*
If the participant picks paper 1, You are in group 1.
If the participant picks paper 2, You are in group 2.
You will be given a set of 20 cards, which each have a different word printed on. You will have 30 seconds and in that 30 seconds I want you to sort the cards into four categories, each category containing 5 words related by, the style of writing *(**group 1**)* / the meaning of the word *(**group 2**).*
((After 30 seconds))
Now I want you to count to 30 in 2s.
((After 15 seconds))-hand out paper
This is a surprise free-recall test. On this paper I want you to write down, in any order, as many of the words as possible. You have 30 seconds.

Debrief

Thank you for taking part in my experiment. The aim of the experiment was to see whether sorting the words by meaning or simply by the style of font would have an affect on the amount of words recalled, if you were not specifically told to learn them. That is why you were asked to pick a hand, participants in group 1 were asked to sort the words according to their font and group 2 were asked to sort the words according to their meaning. I did not mention the recall test because I wanted to investi gate the effect of the levels of processing on your recall ability and not your memory, but if the recall test or any other part of the experiment made you feel uncomfortable or unhappy, please let me know. I also want you to know that you can still withdr aw from the experiment if you wish and your data will not be used.

Do you have any questions?

Thank you.

Appendix 3 **Appendix 4**

Appendix 5

Results

	Number of words correctly recalled	
Participants	**Words sorted by style of font (Group 1)**	**Words sorted by meaning of the word (Group 2)**
1	1	10
2	1	8
3	1	9
4	2	8
5	3	7
6	6	7
7	2	7
8	2	7
9	0	12
10	1	7
Total	1 + 1 + 1 + 2 + 3 + 6 + 2 + 2 + 0 + 1 =**19**	10 + 8 + 9 + 8 + 7 + 7 + 7 + 7 + 12 + 7 =**82**
Mean	19 / 10 =**1.9**	143 / 10 =**8.2**
Mode	**1**	**7**
Median	0, 1, 1, 1, 1, 2, 2, 2, 3, 6 = 2 + 1 / 2 =**1.5**	7, 7, 7, 7, 7, 8, 8, 9, 10, 12 =7 + 8 / 2 =**7.5**
Range	6 – 0 + 1 =**7**	12 – 7 + 1 =**6**