

Effects of deep and shallow processing on memory



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The depth of processing theory states that information is processed at different levels, which influences cognitive performance. The purpose of this study was to examine the effects of depth of processing on memory recall. Past research investigating the depth of processing theory suggests that words processed at a deeper level are more likely to be remembered than words processed at a shallow level. Random assignment was used to assign 152 undergraduates aged 18 to 41 to one of the three levels of processing (i. e., vowel counting, syllable counting, and experience rating). The students were asked to process words according to their condition and then recall as many words as possible. Individuals in the experience rating condition recalled more words than the individuals in the vowel counting and syllable counting conditions. The study supported the depth of processing theory and the hypothesis that processing words on a deeper level leads to better recall. This shows that making information more personal can lead to better recall, which is especially important for students when studying.

An increasing amount of research has been done on depth of processing and its effect on cognitive performance. Craik and Lockhart (1972) proposed that information is processed on different levels, and repetition is not the only way to store memories long term. The depth of processing theory states that information processed at a deeper level is more likely to be remembered than information processed at a shallow level (Craik & Lockhart, 1972). They define deep processing as interpreting information at a semantic level by attaching meaning to information and shallow processing as interpreting information using the senses.

Barker, McInerney, and Dowson (2002) examined whether different motivations and levels of processing affected memory ability. Children were asked different types of questions, which elicited either deep or shallow processing. Rhyming was used as a shallow level, and categorizing and applying meaning were used for deep levels of processing. After the questions, the students were tested to see how many words they recalled. The authors found that more words were remembered using deep processing as opposed to shallow processing.

A lot of studies used depth of processing as an independent variable, even if they studied something other than word processing, and they had similar results (Innocenti et al., 2010; Malmberg & Shiffrin, 2005). Malmberg and Shiffrin (2005) studied the list strength effect by manipulating levels of processing, study time, and massed repetitions. In the levels of processing experiment, three groups were formed. One group looked at words using deep questions, and one group looked at words using shallow questions. The third group studied a mixture of both types of processing. The shallow questions asked whether a certain letter could be found in the word. The deep questions asked whether something was dead or alive. The experiment involving levels of processing found that participants remembered more words in free recall with pure-deep lists than pure-shallow lists. There was not a significant difference between lists of mixed words. Innocenti et al. (2010) investigated the areas of the brain that worked during different levels of processing. Participants were asked questions about words that required semantic or shallow processing. Participants were given a test with a combination of deep and shallow processing questions. As with Malmberg

and Shiffrin (2005), they asked participants to look for a certain letter in a word for shallow processing, and for deep processing, they were asked whether the item was living or not. Both of these experiments showed that deeper processing resulted in better accuracy during recall.

The study of depth of processing and cognitive performance is important, especially to students because it may help with studying techniques and increase memory. If a deeper level of processing led to better recall, students should study by making personal connections or trying to understand the meaning behind terms. Rose, Myerson, Roediger, and Hale (2010) studied the effect of levels of processing on working memory and long term memory. They did two experiments testing the number of words recalled after each task. In the first experiment, participants matched words by color, rhyming, or meaning depending on the depth of processing for that question. They were asked to recall as many words as possible in the same order that they were asked in immediately after answering the questions. After doing a meaningless task, participants were given another test to measure long term memory. In this test, they rated words depending on how confident they were that the word appeared in the first round of questions. The second experiment did the same thing, but some of the participants were not given a test immediately after completing the questions. In these questions, participants counted vowels instead of matching colors. The experiments both revealed that depth of processing did not have an effect on the first test because there was not a significant difference between the three levels of processing, but it did have an effect on the second. Words

that were processed deeply were recalled more often than those that were processed at a shallow level.

Another study took a different approach but came up with more results that supported the depth of processing theory. Kronlund and Whittlesea (2005) gave their participants a series that included questions requiring deep and shallow processing. All of the questions simply required a “ yes” or “ no” answer. They presented half of the words once and half of the words twice. During the testing, participants were showed the words again and asked how many times the word appeared in the questions. Questions that involved deeper processing were answered correctly more often, but they also resulted in more confidence that the word had been shown more than once, even if it was not. This study took a different approach and brought up an issue with depth of processing, but the participants did answer correctly more often when the words were processed deeply.

The current study will examine how college students process words with the depth of processing theory as the basis. Participants will process words at a shallow or a deep level, and then write down as many words as possible. Based on past research, it was expected that college students using deep processing would remember more words than those processing at a shallow level (Craig & Lockhart, 1972; Barker, McInerney, & Dowson, 2002).

Method

Participants

There were 224 students from the Psychology Subject Pool who were randomly selected from introductory psychology courses to participate in the

study. Of those students, 152 participated in exchange for one hour of course research credit. Participant attrition was due to scheduling conflicts or students dropping the course. The sample consisted mostly of females (53.3%), and the majority of students in the study were freshmen (62.3%) or sophomores (27.2%). Their ages ranged from 18 to 41 years with a median age of 19 (SD = 3.01).

Measures

Demographics questionnaire. On the demographics questionnaire, participants reported their age, gender, and year in school.

Word stimulus and processing task. This was a between-groups design. The participants were randomly assigned to one of three levels for their processing task (i. e., counting syllables, counting vowels, or rating experience). The counting syllables and counting vowels conditions were both shallow processing, and the rating experience condition was deep processing. The word stimulus consisted of a PowerPoint presentation with 20 words projected in three second intervals in front of a classroom. While the words were on the screen, the participants had to process them according to their condition. The 60 participants assigned to the vowel counting condition were asked to count all of the vowels in the words on the screen and write the corresponding numbers on their sheet. The 50 participants assigned to the syllable group were asked to count the syllables in each word and write that number on their sheet. The 42 participants assigned to the experience group were asked to rate their experience with the word on a scale from 1 (no experience) to 10 (a lot of experience).

Recall. Participants were asked to remember as many words as they could from the word stimulus and write them in the blank space on their processing task sheet. They were given three minutes. The number of words correctly recalled was summed for the participant's score. The scores could range from 0 to 20. A higher number meant higher cognitive performance.

Procedure

After informed consent was received, the participants filled out their demographics questionnaire. The participants were then asked to read the written instructions for their processing task. Once they finished reading the instructions, the PowerPoint word stimulus was started, and the processing task began. Then they completed the recall portion of the study. The participants were debriefed at the conclusion of the study.

Results

A one-way analysis of variance (ANOVA) with the alpha level set at .05 was conducted to examine differences between three levels of processing (i. e., counting vowels, counting syllables, and rating experience) on the number of words recalled from the word stimulus task. The ANOVA revealed a significant difference in memory recall between the three levels of processing, $F(2, 146) = 21.95, p < .001, \eta^2 = .231$.

Tukey's test was conducted for post hoc comparison to determine where the significant mean differences were located. Individuals in the experience rating condition ($M = 9.19, SD = 2.67$) recalled more words than the individuals in the vowel counting condition ($M = 5.61, SD = 3.01$) and the syllable counting condition ($M = 6.46, SD = 2.41$). Furthermore, individuals

in the vowel counting condition and the syllable counting condition remembered the same amount of words. See Figure 1 to see the mean differences in recall based on depth of processing.

Discussion

Review of Findings

We expected that college students using deep processing during the word stimulus task would recall more words than those processing words at a shallow level. This hypothesis was supported by this study because the students in the experience rating condition remembered more words than the other two conditions. According to Craik and Lockhart (1972), this is because the participants in the experience rating condition processed at a deep level by attaching meaning to them. This is consistent with past research that words processed semantically were recalled more often than words processed shallowly (e. g., Barker, McInerney, & Dowson, 2002; Innocenti et al., 2010; Kronlund & Whittlesea, 2005; Malmberg & Shiffrin, 2005; Rose et al., 2010). There was not a significant difference between the syllable counting and vowel counting conditions, and since these both require shallow processing, this supports the depth of processing theory.

Limitations

Since all of the participants were college students, the issue of generalizability should be raised because a restricted population was used. Students tend to have high cognitive skills, so the results may not be the same for the rest of the population. Testing participants of all conditions in the same room may have caused problems because the students could not ask specific questions, and some students did not fully understand the

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instructions. A survey was not done to see if the participants knew what we were studying, so demand characteristics could have played a role in the results. Deception was used during informed consent, so this was not likely.

Future Directions

Perhaps future research could study depth of processing in a more realistic setting that would be more like a typical learning environment for college students. Instead of processing single words, it would be beneficial to study processing of different kinds of information. Using larger paragraphs or longer questions that relate more to what college students actually learn may bring results that could really benefit students. Since this research was consistent with past studies, it is logical that the depth of processing theory should be studied in a more complex and realistic manor. This study focused on immediate free recall, so it could be beneficial to give another test a few hours later to see if deeper processing has as much of an effect on long term memory.

Implications

The present findings add to the increasing amount of literature on the depth of processing theory because they confirm that processing words at a deeper level leads to better recall than words processed at a shallow level. These results indicate that memory should be looked at as a result of cognitive processes. These results could be very beneficial for people, especially students, with improving memory. Using deeper processing when studying, could lead to better memory. Applying the depth of processing theory to teaching styles by making information personal would increase learning.