

EFFECTS OF STUDY TIME AND LEVELS OF PROCESSING ON TEST PERFORMANCE

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BY

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**ABSTRACT**

**THESIS:** Effects of Study Time and Levels of Processing on Test Performance

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Increased study time and deeper levels of understanding lead to improved test performance. Some research has suggested that deeper levels of processing were a consequence of increased study time, which led to improved test performance. However, educational research suggests that study strategy is more indicative of academic performance than study time. Two experiments were conducted in order to disentangle the effects of study time and study strategy on test performance. For both experiments, participants read an article, were randomly assigned to study elaboration or memorization flashcards, and took a test. In Experiment 1, study time was not controlled. Experiment 2 followed the same procedure as Experiment 1, except participants were randomly assigned to study for 7.5 or 15 minutes. For Experiment 1, the elaboration group studied longer ( $t(68) = 2.06, p = .046$ , Cohen's  $d = .44$ ), but spent less time than the memorization group processing the study material ( $t(68) = 3.04, p = .003$ , Cohen's  $d = .73$ ). The elaboration and memorization groups scored better on the test than the control group ( $\chi^2(2, N = 97) = 23.71, p < .001$ , Cramer's  $V = .25$ ). For Experiment 2, the extended study group scored better than the brief study group ( $F(1, 119) = 7.62, p = .006, \eta^2_p = .06$ ), and the elaboration group scored better than the memorization group ( $F(1, 119) = 16.25, p < .001, \eta^2_p = .12$ ). These results were supported when the test scores were adjusted for the number of words in the study materials. These findings suggest that study time and study strategy acted independently to affect test performance. Additionally, the effect of total time appeared to be nullified when processing time was not controlled.

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### Effects of Study Time and Levels of Processing on Test Performance

Test preparation is regularly regarded in terms of study time and study strategy. Consequently, study time and academic success are often considered synonymous by teachers, students, and researchers (Christopoulos, Rohwer, & Thomas, 1987; Delucchi, Rohwer, & Thomas, 1987). Although study time can be considered a principle factor relating to academic success, some research has postulated that how study time is spent is more important than the amount of time spent studying (Delucchi et al., 1987; Kember, Jamieson, Pomfret, & Wong, 1995; Schuman, Walsh, Olson, & Etheridge, 1985).

In order to observe how students manage their time and effort in school, Delucchi et al. (1987) monitored the study time and class performance of junior high, high school, and undergraduate level students. Undergraduate students spent more time studying than high school students, and high school students studied longer than junior high students. Although study time increased with grade level, there was no correlation between study time and term grade at any grade level. Delucchi et al. (1987) concluded from these findings that contrary to Cooper and Pantle's (1967) total time hypothesis, total time spent studying may not be a key determinant of academic achievement.

To further investigate the effects of study time on academic achievement, d'Ydewalle, Swerts, and Corte (1983) measured the study time of undergraduate students preparing for multiple choice and open response format tests. Students preparing for the open response test spent more time studying than students preparing for the multiple choice test. Also, students preparing the open response test scored better on both test formats than students that prepared for the multiple choice test. From these results, d'Ydewalle and colleagues (1983) made two important presumptions: (1) The students expected the open response test to be more difficult, and (2) the students who expected the more difficult test used deeper learning methods. d'Ydewalle et al.'s (1983) presumptions are supported by findings that;

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(1) students perceive multiple choice exams as less difficult than other formats (Sax & Collet, 1968; Schouller & Prosser, 1994), and (2) students who study longer are more likely to perform better on exams (LaPorte & Nath, 1976). Although d'Ydewalle et al.'s conclusions seem plausible, they did not collect any direct evidence that increased study time resulted in a deeper understanding of the studied material.

To approach this issue from a different perspective, Keith (1982) conducted a path analysis to determine if the amount of time spent on homework affected student achievement. This path analysis suggested that students of a higher ability will earn better grades than students of a lower ability, but students of all ability levels earn better grades when the amount of time spent on homework is increased (Keith, 1982). This model presents the possibility that both study time and study ability could have been factors confounding d'Ydewalle et al.'s (1983) manipulation.

In their levels of processing framework, Craik and Lockhart (1972) concluded that total time spent studying is only effective to the extent that deep learning methods are implemented. Deep learning is described by Craik and Lockhart (1972) in terms of depth of processing. Depth of processing is synonymous with depth of understanding, and can be understood as the "degree of semantic or cognitive analysis" (Craik & Lockhart, 1972, p. 675) that takes place during perception. This means that when deep learning methods are being used to study, a deep level of processing occurs.

Processing study material typically entails encoding new associations between previously understood concepts, or encoding associations between newly learned information and previously understood knowledge (Entwistle, 2000). Processing that results in a larger number of associations for a concept precipitates a deeper level of understanding for that concept.

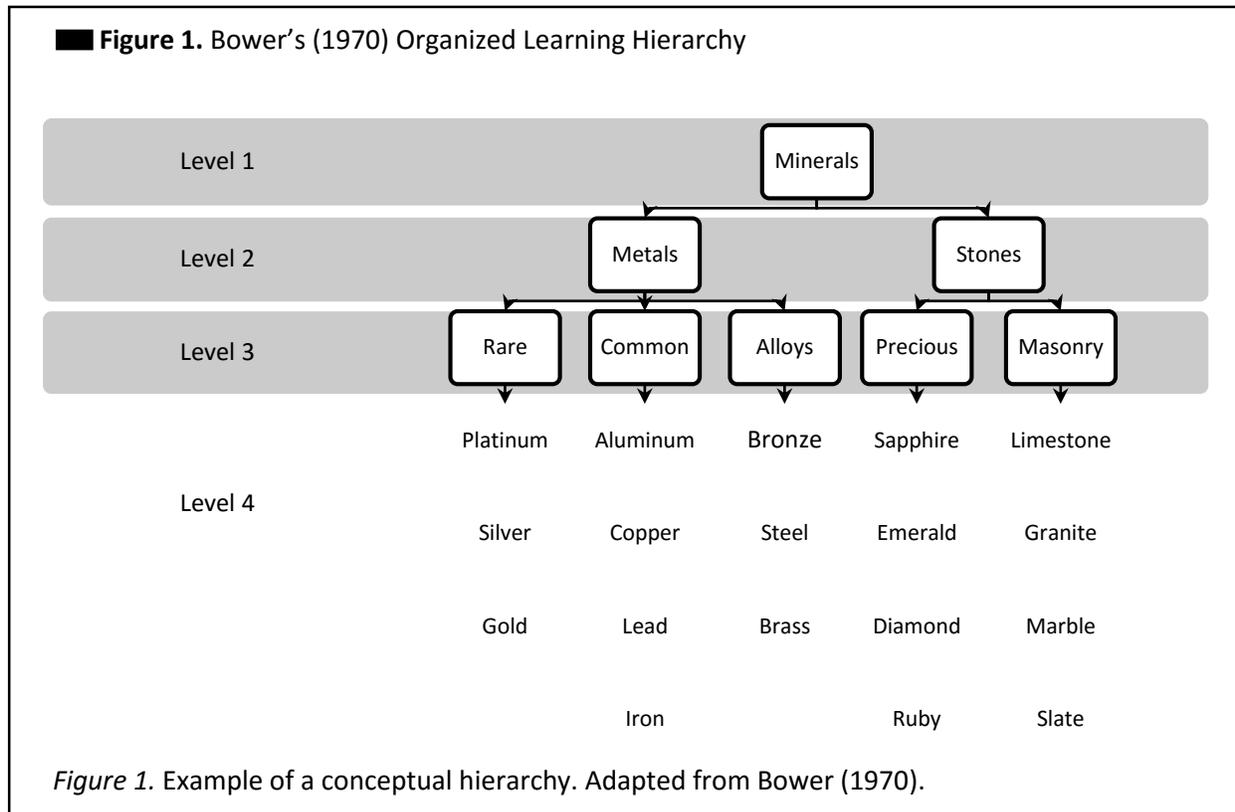
The process of applying multiple approaches to encode these associations is referred to as elaboration (Baddeley, 2000). During elaboration, learners relate and compare new information with

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previous knowledge (Pask, 1976; Pask, 1988). Elaboration occurs by applying deep learning methods that prompt inferences and understanding that expands upon the basic understanding of facts and definitions (Karpicke & Blunt, 2011).

The literature does not appear to identify a specific number of associations that need to be encoded for the level of understanding to be considered deep (Bradshaw & Anderson, 1982). Understanding appears to be judged on a continuum of relative depth. For instance, a concept that has encoded one association has not been processed as deeply as a concept that has encoded two associations. In addition, a concept that has encoded two associations may not necessarily be considered a deep level learning method (Bradshaw & Anderson, 1982). So while level of understanding may be classified at a deep or shallow level, at this time there is no defined processing threshold to differentiate levels of understanding.

Depth of processing is commonly conceptualized by Bower's (1970) theory of organized learning. Bower (1970) proposed that studied information was encoded using a network of associations organized in a hierarchy. In this hierarchy, levels of understanding were distinguished by category (see Figure 1). While this hierarchical structure represented the organization of information, Craik and Lockhart (1972) suggested that the number of associations, and not the number of categorical levels associated with one concept represented the depth of understanding for that concept. So, while deep learning is often conceptualized as the number of levels within a hierarchy, Craik and Lockhart (1972) proposed that deep learning is more accurately described as the spread of encoding that can occur beyond the constraints of a two dimensional hierarchy.



Study strategies that resulted in a shallow level of processing by maintaining an association using repetitive recitation was considered rote memorization (Kornell & Bjork, 2007; Roediger & Karpicke, 2006). Rote memorization refers to the fixated encoding of facts and definitions by reading and re-reading the study material (Dunlosky et al., 2013). Although previous research found that rote memorization took less time to process than elaboration (Hilgard, Irvine, & Whipple, 1953), the redundancy of repetitive recitation points to a lack of efficiency. Further, Roediger and Karpicke (2006) determined that repetitive recitation was not an effective method for encoding newly learned information into long term memory. Overall, rote memorization is generally considered a method of learning that results in an atomistic, or shallow level understanding for the material (Entwistle, 2000).

Generally, elaboration results in a deeper level of understanding than rote memorization ( Craik & Lockhart, 1972). Rote memorization is concerned with encoding a single association via repetitive

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recitation. Elaboration works to develop multiple associative connections by encoding a variety of inferences and relationships.

If learned associations are not reinforced, they will degrade over time ( Craik & Lockhart, 1972). Concepts that have undergone elaboration have more associations to degrade before the new information is forgotten (cf. memorized concepts; Craik & Tulving, 1975). Therefore, using elaboration to develop multiple conceptual relationships improves retention when compared to the process of reciting a single association that must be repeatedly supported by rote memorization (e.g., Bobrow & Bower, 1969).

Arguments have been made from an interference perspective that recording multiple associations related to the same stimulus could actually make recall more difficult and less accurate (Wickelgren, 1973). The research in response to these concerns has consistently found that elaboration as a form of associating related information results in improved recall (i.e., Bower & Bolton, 1969; Bradshaw & Anderson, 1982). Despite consistent findings that depict repetitive recitation a method of study that is less efficient than elaboration, most students appear to rely on memorization when studying (e.g., Christopoulos et al., 1987; Karpicke, Butler, & Roediger, 2009).

In a study similar to Delucchi et al.'s (1987), Christopoulos and colleagues (1987) developed and administered the Study Activities Survey to junior high, high school, and undergraduate students to measure their reliance on shallow and deep level learning processes. Results from the survey indicated that students relied mostly on processing the study material at a shallow level. In addition, the use of study strategies that promoted deep learning was negatively correlated with grade level. As students advanced in grade level, they monitored their time use more closely. According to Christopoulos et al. (1987), students likely became more careful about monitoring their time use because the workload associated with class generally increased with grade level.

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Altogether it seems that as students advanced in grade level they spent more time studying (Delucchi et al., 1987), and became more concerned with efficiency (Christopoulos et al., 1987). Although students may have been more aware of their time use, they appeared to continue to implement unproductive encoding strategies to learn the study material (Christopoulos et al., 1987; Karpicke et al., 2009). Rather than elaborating information for a deeper level of understanding, undergraduate students often rely on rote memorization as their primary method of study (Karpicke & Blunt, 2011; Dunlosky et al., 2013). This demonstrated dissonance between the intentions and actions of students could be a product of a lacking awareness of how study strategies that promote a deep level of understanding can be used efficiently and effectively (Karpicke & Roediger, 2008; Karpicke et al., 2009).

Rote memorization is likely preferred by students because it takes less time, and is easier to process than elaboration (Entwistle & McCune, 2004). Another possible explanation is that students may not be familiar with deep learning methods that require elaborative processes. In one instance, Tang (2007) found that even students who were aware of the benefits of a deep level of understanding were sometimes unable to apply the necessary learning methods because they did not know how to carry out the elaborative process.

Regardless of the reason why students choose not to elaborate study materials, rote memorization appears to provide undergraduate students with an “illusion of competence” (Karpicke et al., 2009, p.478). Most naturalistic methodologies point to students relying on rote memorization (e.g., Christopoulos et al., 1987; Delucchi et al., 1987; Karpicke et al., 2009), whereas experimental research has approached this problem as if deeper levels of understanding were a natural consequence to increased study time (e.g., d’Ydewalle et al., 1983). While it is apparent that processing depth is associated with study time, there is no clear evidence that points to study time as a cause of deeper levels of understanding. This sentiment appeared to be echoed by Kember et al. (1995) who, despite finding that students using elaborative learning methods were not successful if they did not study for a

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substantial amount of time, pointed out that students would benefit from individual study counseling. Everything considered, the process of elaboration does not appear to be entirely intuitive and should not be treated as a side effect of study time.

### **Experiment 1**

While there is a general accord that the application of deep study strategies is a strong predictor of academic success, the cognitive processes underlying deep levels of processing are still unclear. The purpose of this study was to disentangle the effects of study time and study strategy on student learning. Two separate experiments were conducted to examine the effects of study strategy and study time on test performance.

Experiment 1 was meant to replicate previous studies by measuring study time and test performance. Experiment 1 was conducted prior to Experiment 2 because a secondary purpose for Experiment 1 was to determine the amount of time that would be appropriate for a study time manipulation in Experiment 2. For Experiment 1, participants read an article, studied flashcards meant to promote elaboration or memorization, completed a distraction task, and took a test. The control group did not study any flashcards, but still completed the distraction task.  $H_1$ : Participants in the elaboration group will study longer than participants in the memorization group.  $H_2$ : Participants in the elaboration group will have higher test scores than participants in the memorization and control groups.

### **Methods**

#### **Participants**

The sample consisted of 97 undergraduate students that reflected a cross section of all majors at Ball State University. The participants were mostly white (84.5%) women ( $n = 67$ ) between 18 and 50 years old ( $M$  age = 21.6 yr.,  $SD = 5.7$ ). Participants were awarded class credit for participation.

### **Materials and Procedure**

The entire procedure was contained within a Qualtrics online survey. The study was conducted over the internet because this method is considered exceedingly more efficient than meeting in a research laboratory, and the resulting responses have been found to be reasonably equivalent to those acquired in the laboratory setting (Butler, 1986; Whitley & Kite, 2013).

Informed consent was provided on the first page of the survey. After agreeing to participate, participants were given a short and detailed briefing to ensure they understood the procedure. The briefing explained that a score of 75% on the test was necessary to exhibit adequate comprehension of the material. Participants were led to believe that if they scored below a 75% on the exam they would be asked to re-study the material and take another comprehension test. This deception was presented to the participants to help motivate students to study the material and perform to the best of their ability on the test.

When the participants completed the briefing, they navigated to the reading material. The reading material consisted of Matthews' (2014) research article titled "Hoarding Disorder: More than just a problem of too much stuff" (see Appendix A). This article contained 1,926 words. This article was chosen because there was enough detail to make the test difficult, but the information did not contain an excessive amount of technical terms that could be difficult for participants to understand. Definitions that were likely beyond a colloquial level of understanding were accompanied with a definition to improve readability.

After 10 minutes, participants were automatically redirected to the study material. After being redirected, participants were not allowed to navigate back to the reading material. The study material consisted of flashcards designed to prepare the participants for a multiple choice test.

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Participants were randomly assigned to only read the article, or read the article and study shallow or deep level flashcards created by the researchers. The control group read only the article. The memorization group read the article and studied shallow level flashcards (see Appendix B). All of the flashcards consisted of two sides. Side A posed a question (e.g., *What are typical symptoms of HD?*), and Side B provided a response that contained definitive or factual information found in the article (e.g., *A desire to save and difficulty or indecision discarding items.*). The elaboration group read the article and studied deep level flashcards (see Appendix C). The elaboration group flashcards were identical to the memorization group flashcards except an applied example was provided in addition to the factual information presented on Side B (e.g., *For example, if an HD patient received a pair of shoes that did not fit, that HD patient would be inclined to store that pair of shoes.*). All of the flashcards were matched for content. Each test question corresponded to at least one elaboration and memorization flashcard. There were the same number of elaboration and memorization flashcards. Some test questions related to more than one elaboration or memorization flashcard.

Test questions and flashcards were presented in chronological order to match the presentation of content in the reading material. There were 20 elaboration flashcards and 20 memorization flashcards. The elaboration flashcards consisted of 796 words total, and the memorization flashcards consisted of 383 words total. Each flashcard was presented individually to the participants. Participants were only able to navigate forward through the flashcards. The participants read all of the flashcards at a self-determined pace.

When participants read every flashcard one time, they were directed to a distraction task designed to clear the working memory. The control group completed the distraction task immediately after reading the article. To complete this distraction task, participants were asked to provide their demographic information (see Appendix D). The distraction task consisted of enough questions to insure

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that the participants' attention is occupied for at least one minute. The participants were asked to complete as many of the demographics questions as possible.

After one minute participants were automatically redirected to the test. The test consisted of 14 multiple choice questions (see Appendix E). Half of the questions on the test assessed deep level knowledge using comparison (e.g., *How is the incidence of hoarding disorder (HD) throughout the lifetime related to the severity of HD symptoms?*). In order to avoid testing the memorization group on information that was not studied, none of the test questions referred to any of the examples provided on the elaboration flashcards. The other half of the questions assessed shallow level knowledge such as facts and definitions (e.g., *What symptoms are commonly exhibited in patients with hoarding disorder (HD)?*). All of the questions were presented in chronological order, as they were introduced in the reading material. Each question showed four possible answers. Participants were directed to select the best answer available.

Upon completing the test, all participants were directed to a screen stating that they had completed the research study. Participants were informed that there actually was no minimum score requirement. No participants were required to re-study the material or re-take the exam, regardless of how they scored on the test. Participants were able to view their test performance and saw their actual score after completing the survey.

### Results

Study time was defined as the amount of time spent reviewing the flashcards. The study time was collected automatically using the meta data function in Qualtrics. Study time was measured in seconds (s). Because the elaboration study materials consisted of more words than the memorization study materials, study time was controlled by calculating the processing time. Processing time was

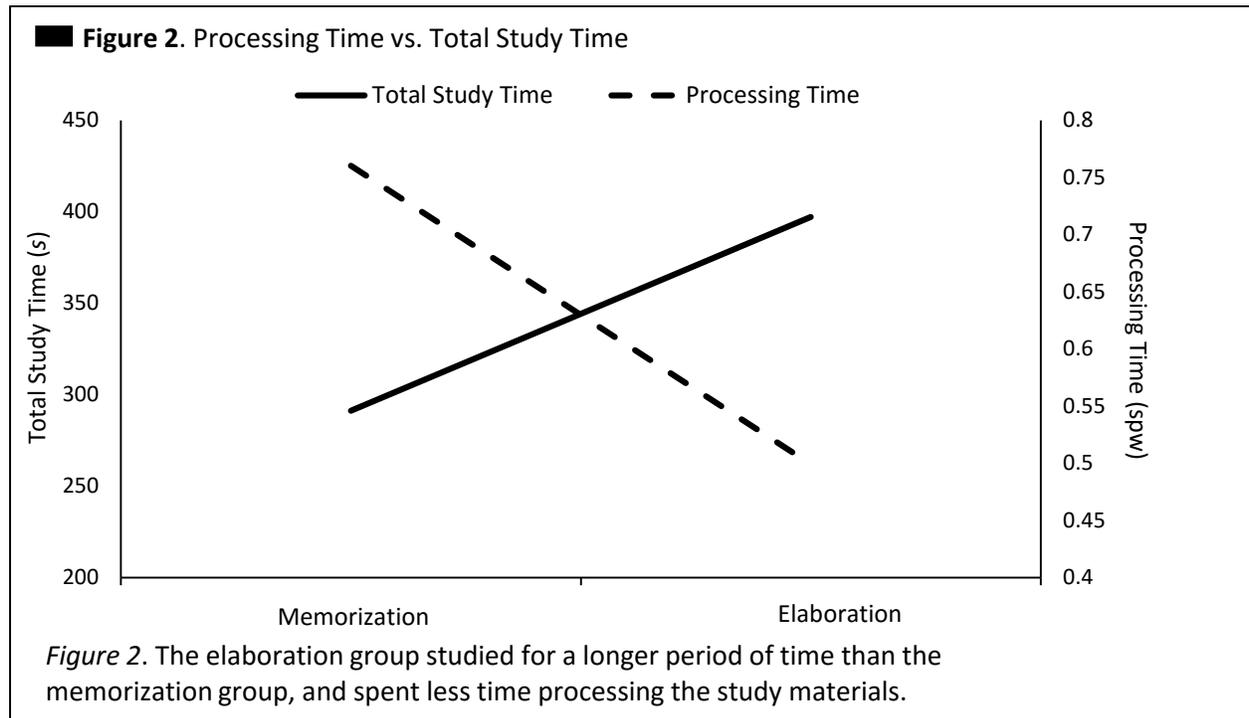
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measured in seconds per word (spw). Processing time was calculated by dividing the total amount of time spent studying by the number of words on the flashcards.

Study time for the elaboration and memorization groups appeared to be positively skewed. Levene's test of homogeneity of variances was not significant, confirming homogeneity of variances between the groups. Although the study time data was skewed, the variances were equal and a quantile-comparison plot appeared to show relative normality, so an independent samples *t*-test was used to evaluate study time.

Processing time showed a more pronounced positive skew than study time. Although Levene's test of homogeneity of variances was once again not significant, the quantile-comparison plot did not appear to reflect a normal distribution. A natural log transformation was applied to the processing time data to correct the abnormality. The transformation resulted in a normal distribution for the processing time variable. An independent samples *t*-test was used to evaluate processing time for the transformed data.

The independent samples *t*-test for total study time ( $t(68) = 2.06, p = .046, \text{Cohen's } d = .44$ ) showed that the memorization group ( $M = 291.21s, SD = 177.89s$ ) took less total time to study than the elaboration group ( $M = 397.22s, SD = 242.94s$ ). Conversely, the Independent samples *t*-test for processing time ( $t(68) = 3.04, p = .003, \text{Cohen's } d = .73$ ) showed that the memorization group ( $M = .76\text{spw}, SD = .47\text{spw}$ ) took more time per word to study than the elaboration group ( $M = .50\text{spw}, SD = .31\text{spw}$ ). See Figure 2 for a graphical comparison of processing time and total study time.



The test scores for the three groups showed a negative skew, thus compromising normality. Levene's test of homogeneity of variances was not significant, confirming homogeneity of variances between the groups. Because the data was skewed and a quantile-comparison plot did not reflect a normal distribution, but the variances were equal, the Kruskal-Wallis Rank Sum Test was used as a nonparametric substitute for a one-way ANOVA to evaluate the test scores.

The Kruskal-Wallis Rank Sum Test indicated a difference between groups:  $\chi^2 (2, N = 97) = 23.71$ ,  $p < .001$ , Cramer's  $V = .25$ . Tukey's pairwise comparisons (see Table 1) showed that the elaboration ( $M = 7.14$ ,  $SD = 2.10$ ) and memorization ( $M = 7.97$ ,  $SD = 1.90$ ) groups both scored better on the test than the control group ( $M = 5.04$ ,  $SD = 2.05$ ). There was no difference in test scores between the elaboration group and the memorization group.

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Table 1  
*Tukey's Pairwise Comparisons for Study Strategy*

		<i>Difference</i>	95% CI		<i>p</i>
			<i>Lower</i>	<i>Upper</i>	
Control	Memorization	-34.43	-51.77	-17.09	0.012
	Elaboration	-25.08	-41.99	-8.17	0.000
Elaboration	Memorization	-9.35	-25.35	6.64	0.485

**Discussion**

The hypothesis that the elaboration group would study longer than the memorization group was partially supported. The results showed that although the elaboration group did study longer than the memorization group, the memorization group took more time to process the material. Additionally, the hypothesis that the elaboration group would score better on the test than the memorization and control groups was also partially supported. Although the elaboration group scored better on the test than the control group, there was no significant difference in the test scores for the memorization and elaboration groups.

There was a difference between the elaboration and memorization groups for both study time and processing time, but no difference in test performance between the two groups. Also, it should be noted that the magnitude for the effect of processing time (Cohen's  $d = .73$ ) was much stronger than the magnitude for the effect of study time (Cohen's  $d = .44$ ). Contrary to d'Ydewalle et al.'s (1983) presumption that increased study time led to a deeper level of processing, the elaboration group spent more time studying and studied more elaborative material than the memorization group, yet there was no difference in test performance between the two groups.

The relative similarity in performance between the elaboration and memorization groups also points to a conflict with the widely accepted total time effect (Cooper & Pantle, 1967). This point can be reconciled when considering processing time. The disproportionate amount of material in the two study

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conditions yields two total time possibilities: (a) total time spent studying (i.e., study time), and (b) total time spent studying when study time was controlled for number of words in the study material (i.e., processing time). The elaboration group benefitted from more time spent studying, but the memorization group benefitted from more time spent studying when study time was controlled for the number of words in the study material.

Given that the memorization group did not spend as much total time studying as the elaboration group yet scored slightly better on the test, we concluded that the memorization group compensated for the lack of elaborative material by taking more time to process the study materials. It is impossible to say whether this increased processing time was due to the use of elaborative techniques or repetitive recitation. Given that elaborative techniques take longer than rote memorization (Hilgard et al., 1953) and the total time of the elaboration group was longer than the memorization group, we surmised that the memorization group utilized repetitive recitation methods to study the materials. It is likely that the elaboration group also used repetitive recitation methods to study and relied on the depth of the study material (i.e., the additional examples) to increase their depth of understanding.

Despite learning the material at a deeper level of processing, the elaboration group did not outperform the memorization group on the test. This could mean that the manipulation was not strong enough. Future studies may benefit from providing multiple examples, or different elaborative strategies to insure that the elaborative study material is sufficiently deeper than the memorization materials.

### **Experiment 2**

The purpose of Experiment 2 was to differentiate the effects of study time and study strategy by manipulating processing time. Based on findings from Experiment 1, participants were allotted a brief (7.5 minutes) or extended (15 minutes) period of time to study flashcards meant to promote elaboration

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or memorization and take a test. The exact same reading material, flashcards, distraction task, and test questions from Experiment 1 were used in Experiment 2 (see Appendices A, B, C, D, E, & F).  $H_1$ :

Participants in the elaboration group will have higher test scores than participants in the memorization group.  $H_2$ : Participants in the extended study group will have higher test scores than participants in the brief study group.

### Methods

#### Participants

The sample consisted of 123 undergraduate students reflecting a cross section of all majors from Ball State University. The participants were mostly white (84.6%) women ( $n = 92$ ) between 18 and 37 years old ( $M$  age = 20.8,  $SD = 2.9$ ). The participants were awarded class credit for participation. This was not the same sample of participants who participated in Experiment 1.

#### Materials and Procedure

All of the materials used in Experiment 1 were used in Experiment 2. The participants in Experiment 2 followed the same procedure as the participants in Experiment 1, except the study time was controlled in Experiment 2. Participants were randomly assigned to study deep (elaboration) or shallow level (memorization) flashcards for a brief study period (7.5 minutes) or extended study period (15 minutes).

Because study time was controlled, participants were not able to control the speed at which the flashcards were presented, or go back to re-read a flashcard. The Qualtrics program controlled the amount of time participants spent studying each flashcard. The flashcards presented themselves for a set amount of time determined by the number of words on the flashcard. In order to make sure that participants were actually attending to the flashcards, the participants were required to check-in at

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random intervals during the presentation of the study material. These check-ins simply presented a flashcard that explained that they must click forward to continue studying.

Although the study time was controlled by presenting the flashcards for a predetermined number of seconds per word, the elaboration flashcards contained 413 more words than the memorization flashcards. Because all of the flashcards were presented for 0.57spw during the brief study period, the total study time for the memorization group was 235.41s shorter than the elaboration group. During the extended study period, the flashcards were presented for 1.14spw, making the total study time for the memorization group 470.82s shorter than the elaboration group. The amount of time that the memorization flashcards was presented was not adjusted to make up this deficit because this would actually be providing the brief study group relatively more time to process less material.

To account for the extra time, participants in the memorization group completed a puzzle task after reading the article. This allowed for all of the groups to have to the same amount of time between reading the article and taking the test, and the same amount of time between studying and taking the test. For the puzzle task, participants attempted to complete a difficult word search titled "Getting to Know Indiana." The word search had 50 hidden words that related to the state of Indiana. This theme was chosen because there was no information that would likely interfere with the encoding of the information presented in the article. When the time ran out, the participants were automatically redirected to the memorization study materials. None of the participants completed the word search before the time ran out.

In order to determine the brief study period, the minimum amount of time necessary for participants to read the flashcards was calculated based on processing times from Experiment 1, then applied to the elaboration group. The elaboration group was used as the baseline for total study time because the elaboration study materials contained more words than the memorization study materials.

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The mean study time per word for the elaboration group from Experiment 1 ( $M = .50\text{spw}$ ) was used as a baseline for determining the study time for the brief study group. In order to insure that all of the participants would be able to effectively read the material, a one-minute buffer was added to the total study time. This method resulted in a study time of 7.5 total minutes for the brief study group.

A reading time of  $0.57\text{spw}$  amounts to a reading pace of 105.2 words per minute (wpm). Given that college students generally read at a pace of about 300wpm (Carver, 1992; Taylor, 1965), the 7.5-minute study time was not expected to affect the participants' ability to read and comprehend the flashcards. While the brief study group was likely able to read all of the flashcards without difficulty, the 7.5-minute study time limit was expected to limit additional processing of the material that might occur beyond the control of the experiment.

The extended study group was given 15 total minutes to study the flashcards. This amounted to a processing time of  $1.14\text{spw}$ . Study time for the extended study group was determined by doubling the study time allowed for the brief study group.

When the study time expired, the participants were automatically redirected to the same distraction task used to clear the working memory in Experiment 1. After the participants completed as many demographic questions as possible in one minute, they were automatically redirected to the same test that was administered in Experiment 1.

As in Experiment 1, participants were informed during the briefing that if they did not score a 75% on the test they would be required to re-study the material and re-take the test. No participants were actually held to this standard. When participants completed the test, they were redirected to a screen that informed the participants that they have successfully completed the study and thanked them for their participation. Participants were able to review their test performance and see their actual test score after completing the survey.

## Results

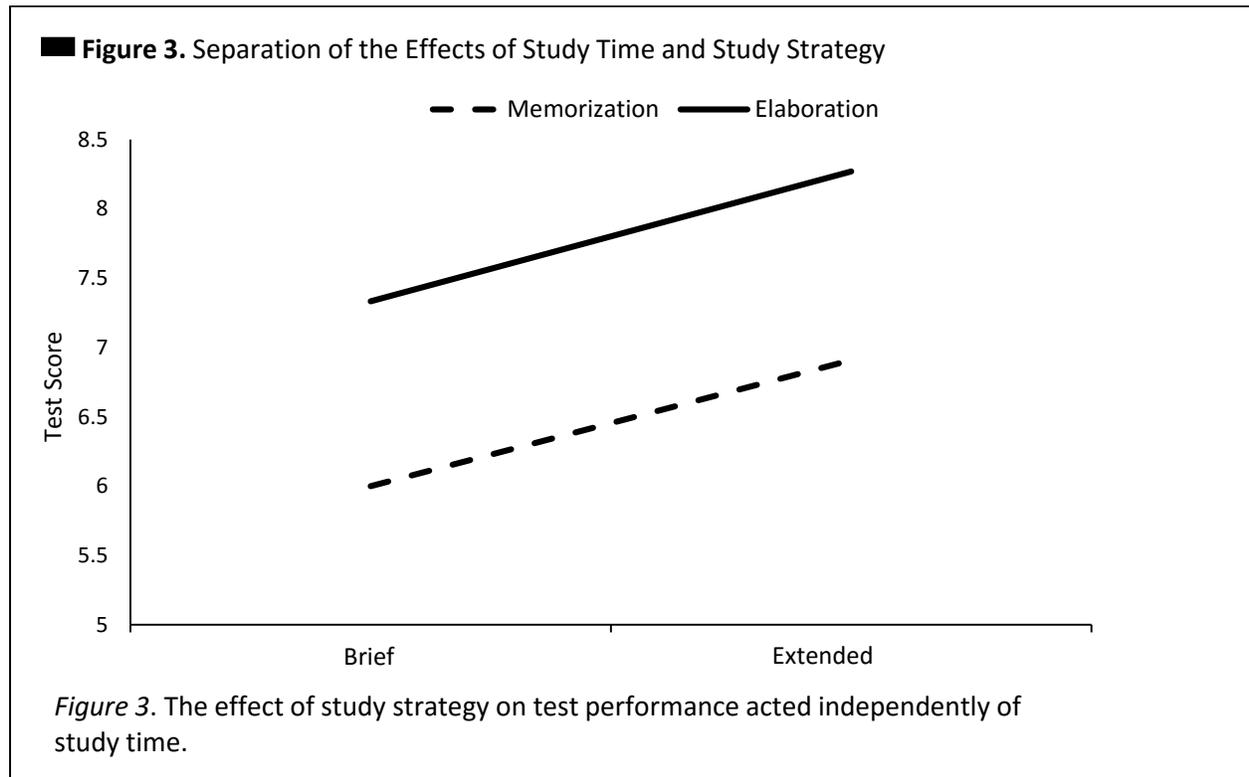
Test performance for the four groups was compared using a 2 (study strategy) x 2 (study time) between-subjects Factorial ANOVA. The normality and homogeneity of variances assumptions were satisfied for this parametric analysis.

The descriptive statistics for each group are presented in Table 2. The main effect for study time yielded an  $F$  ratio of  $F(1, 119) = 7.62, p = .006, \eta^2_p = .06$ , indicating that the extended study group ( $M = 7.51, SD = 2.10$ ) scored better than the brief study group ( $M = 6.69, SD = 1.81$ ). The main effect for study strategy yielded an  $F$  ratio of  $F(1, 119) = 16.25, p < .001, \eta^2_p = .12$ , indicating that the elaboration group ( $M = 7.75, SD = 1.81$ ) scored better than the memorization group ( $M = 6.47, SD = 1.96$ ). There was no significant interaction. See Figure 3 for a graphical comparison of study time and study strategy.

Table 2

*Means and Standard Deviations for Study Time and Study Strategy*

	Memorization		Elaboration	
	<i>n</i>	<i>M (SD)</i>	<i>n</i>	<i>M (SD)</i>
Brief	32	6.00 (1.55)	34	7.33 (1.77)
Exented	33	6.91 (2.17)	28	8.27 (1.68)



Because the memorization and elaboration groups actually studied the flashcards for differing amounts of time, the test scores were adjusted so they accounted for the amount of time spent studying per word. This was accounted for by multiplying the test scores by study time per word. The adjusted study time scores are presented in Table 3.

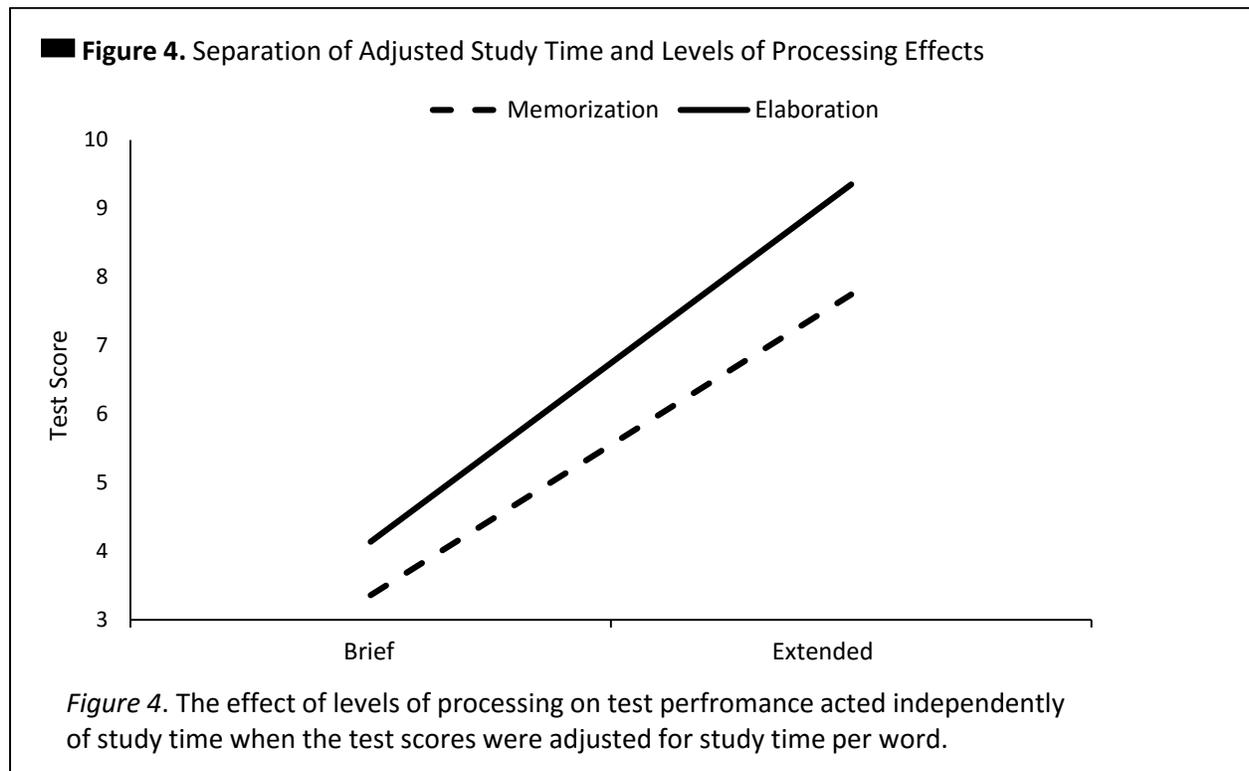
Table 3  
*Descriptive Statistics for Adjusted Study Time*

	Memorization		Elaboration	
	Study Time (spw)	<i>M</i> ( <i>SD</i> )	Study Time (spw)	<i>M</i> ( <i>SD</i> )
Brief	0.56	3.36 (0.88)	0.57	4.14 (1.02)
Exented	1.12	7.75 (2.47)	1.13	9.35 (1.93)

When the data was adjusted, the outcome depicted by the original analysis was not affected. The main effect for study time yielded an *F* ratio of  $F(1, 119) = 242.36, p < .001, \eta^2_p = .67$ , indicating that the extended study group ( $M = 8.55, SD = 1.23$ ) scored better than the brief study group ( $M = 3.75, SD =$

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0.95). The main effect for study strategy yielded an  $F$  ratio of  $F(1, 119) = 15.05, p < .001, \eta^2_p = .11$ , indicating that the elaboration group ( $M = 6.75, SD = 1.48$ ) scored better than the memorization group ( $M = 5.55, SD = 1.67$ ). There was no significant interaction. See Figure 4 for a graphical comparison of study time and study strategy.



### Discussion

Both hypotheses that the elaboration groups would score better than the memorization groups, and the extended study groups would score better than the brief study groups, were supported. The results indicated that increased study time led to improved test performance, but this effect was independent of the effect that study strategy had on performance. While both factors affected test performance, these results indicated that study strategy ( $\eta^2_p = .12$ ) had a larger effect on test performance than did study time ( $\eta^2_p = .06$ ).

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It could be argued that the elaboration group was still allowed more total study time than the memorization group. Because the processing time was held constant, the elaboration group was not provided more of an opportunity to recite or elaborate upon the provided materials than was the memorization group. In this aspect, the only difference between the two groups was study strategy.

To further clarify the relationship between study time and study strategy, the adjusted study time was calculated and applied to the test scores. These results confirmed the original findings that study time and study strategy acted independently on test performance. When the adjusted study time scores were calculated, the effect for study time on test performance became much stronger ( $\eta^2_p = .67$ ) as compared to the non-adjusted study time test scores. Additionally, the effect for study strategy when study time test scores were adjusted ( $\eta^2_p = .11$ ) was not affected. This shows that when the amount of study material was controlled, study time was a major factor in determining test performance. Additionally, study time did not appear to affect the relationship between study strategy and test performance.

Controlling the processing time resulted in a clear depiction of the effects of processing depth and study time on test performance (see Figures 3 & 4). This control of processing time allowed the confounded results from Experiment 1 to be clarified. Further, the previous conclusions of d'Ydewalle et al. (1983) presumed that increased study time led to a deeper level of understanding. The results of the current study suggest that study time improved test performance, but did not affect processing depth; and processing information at a deeper level improved test performance, but did not affect processing time.

### **General Discussion**

To summarize the findings of this study, deeper levels of processing and increased study time led to improvements in test performance when processing time was controlled. When processing time

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was not controlled in Experiment 1, the total time effect was nullified. When processing time was controlled in Experiment 2, there was a clear total time effect (see Figure 4).

As stated previously, research that has used naturalistic methods to observe the relationship between study time and academic performance have produced findings contrary to the total time effect (i.e., Christopoulos et al., 1987; Delucchi et al., 1987; Karpicke et al., 2009). While initially it seemed that these findings did not support the hypothesized relationship between study strategy and study time, findings from the current study can be applied to explain the discrepancy between the total time effect and some research observing the effect of total study time on academic performance. Christopoulos et al. (1987) pointed out that students increased study time and became concerned with efficiency as the amount of work associated with their course load increased. If this was the case, then the lack of effect for total study time observed in these studies could be a consequence of the nature of the measurement. As in the current study, an increase in the amount of study material will increase total study time, but if processing time is not also increased, then the effect of total study time is likely nullified. This is especially relevant when considering these students were generally relying on rote memorization study strategies (i.e., Christopoulos et al., 1987; Karpicke et al., 2009).

Controlling processing time also proved useful for isolating the effect of study strategy. When processing time was not controlled in Experiment 1, there was no difference in the test scores between the elaboration or memorization groups (see Table 1). When processing time was controlled in Experiment 2 there was a clear difference between the elaboration and memorization groups that was independent of the study time effects. This effect was magnified when the test scores were adjusted for the amount of words in the material relative to the allotted study time.

In order to maximize control, the participants were provided study materials that differed in the amount of the material presented. To avoid providing the elaboration group with additional information

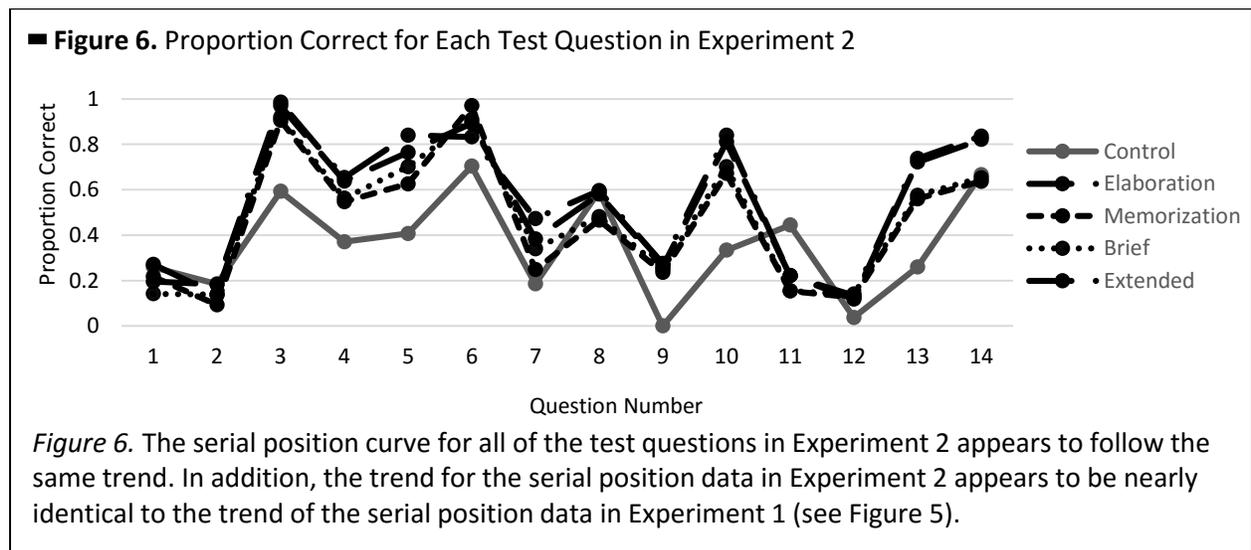
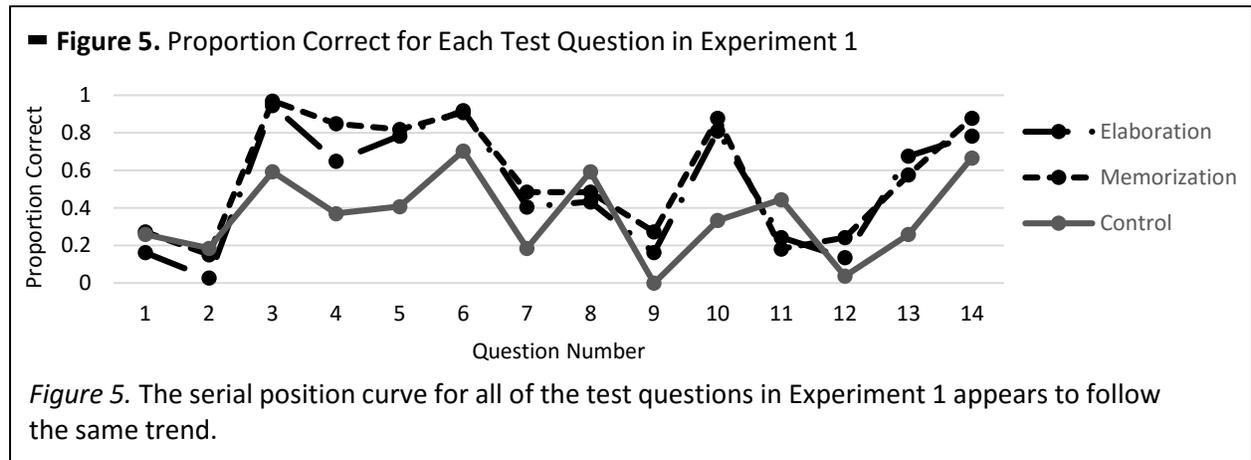
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that would provide an uncontrolled advantage on the test, the examples used in the flashcards did not provide information that would add to the participants' knowledge of the concept, but rather provided a realistic application of the concerned fact or definition. By limiting the study strategy manipulation to realistic examples rather than conceptual knowledge, the elaboration group was not provided with more information that would logically improve their test performance, but were rather provided the same information in a different form that allowed for the encoding of more conceptual associations.

Another factor affecting the study strategy manipulation was the depth at which the information was processed. In Experiment 2 there was a clear difference between the elaboration and memorization groups, but in Experiment 1 there was no difference in test performance between these two groups. It appears that there was no difference between the elaboration and memorization groups in Experiment 1 because the memorization group spent more time processing the study material than did the elaboration group. Because we know from Experiment 2 that the study materials provided to the elaboration group led to better test scores than the material provided to the memorization group, we expect that a stronger manipulation of the depth of processing in Experiment 1 would have resulted in a difference in test scores between these two groups.

Finally, the trend for the scores was similar for all of the groups in Experiment 1 (see Figure 5) and Experiment 2 (see Figure 6). This uniform trend for the individual test questions shows that the study materials and the test questions affected all of the conditions relatively the same. The common trend between participants confirmed that despite the online nature of the study, participant performance was not disproportionately affected by any of the study conditions. This confirmed the conclusion that research conducted using internet technology can be considered reliable although there is generally no personal interaction between the researcher(s) and the participants (Butler, 1986; Whitley & Kite, 2013).

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It would be logical to deduce that if one group was using deep study strategies and the other group was not, the elaborative group would score consistently better, but along the same trend, as seen when comparing the groups that studied to the control group. Although we cannot know for sure the methods utilized by the participants in any group (except the control group), the uniform trends in Figures 5 and 6 led us to infer that most, if not all of the participants likely relied on rote memorization to study for the test.

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This trend may also indicate that the participants in each of the conditions approached the study material in the same way regardless of their assigned condition. As suggested by a large amount of previous literature, undergraduate students tend to rely on rote memorization when studying (i.e., Christopoulos et al., 1987; Delucchi et al., 1987; Dunlosky et al., 2013; Entwistle & McCune, 2004; Karpicke & Blunt, 2011; Karpicke & Roediger, 2008; Karpicke et al., 2009; Kember et al., 1995; Tang, 2007). If this trend followed for the current study, it is likely that all or most of the participants in this study used rote memorization methods to prepare for the test.

### **Conclusions**

The results of this study were used to disentangle the effects of study strategy and study time on test performance by controlling study time, processing time, and study strategy. Both study strategy and study time appeared to play a role in affecting test performance. At first look, study strategy appeared to have a stronger effect on test performance than did study time. When study time was controlled by accounting for the amount of material being studied (i.e., processing time), study strategy appeared to have a much weaker effect on test performance than study time. Controlling processing time did not appear to affect the magnitude of the effect of study strategy on test performance. Therefore, the effects of study strategy and study time appeared to be independent of one another.

The findings of this study suggest that when measuring total study time for study materials of varying depth, processing time must be accounted for to accurately estimate the effect of total study time on test performance. Generally, it seems that the “illusion of competence” (Karpicke et al., 2009, p.478) witnessed in undergraduate students could be based on study time, whereas the results of this study and other previous research shows that actual test performance is largely based on the applied depth of processing ( Craik & Lockhart, 1972; Roediger & Karpicke, 2006).

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While there is reason to believe that the participants in this study relied on rote memorization as a study strategy regardless of their group membership, this conclusion is in need of further research and clarification. Three possibilities for approaching this issue in the future could be to: (a) provide participants with study materials that contain explicit directions that allow the participant to manipulate the depth of processing on their own, (b) ask participants to create their own study materials, or (c) simply ask the participants to complete a survey regarding the study strategies they chose to apply.

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Appendix A

*Reading Material*

*J Clin Psychiatry*. Author manuscript; available in PMC 2015 May 15.

## **Hoarding Disorder: More than just a problem of too much stuff**

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University of California, San Francisco

Compulsive or problematic hoarding behaviors occur in a variety of neuropsychiatric disorders, including obsessive compulsive disorder (OCD), schizophrenia, and dementia. Such behaviors have until recently been considered as a subtype of obsessive compulsive disorder (OCD), despite the fact that clinicians and researchers have long known that these symptoms often occur independently of OCD or other neuropsychiatric disorders. However, with the publication of the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), Hoarding Disorder (HD) has at long last achieved recognition as a clinical syndrome in its own right. Research suggests that this recognition is appropriate, despite the current trend away from disorder-specific approaches and towards crossdiagnostic approaches.

HD is defined as a pattern of persistent difficulties with discarding personal possessions, even those with no clear value, because of strong desires to save along with distress or indecision about what to discard. Difficulty discarding is often, but not always, accompanied by excessive acquiring of unneeded objects, and, in the absence of intervention, leads over time to the accumulation of so many items that the space or room cannot be used for its usual purposes, and thus to substantial functional impairment. This definition allows for a distinction to be made between HD, where the core problem is desire to save leading to difficulty discarding, and hoarding behaviors typically seen in other neuropsychiatric disorders, where the main feature is often excessive collecting or acquiring of rubbish (e.g., cigarette butts, bottles from garbage cans, etc) or passive difficulties with discarding. HD does co-occur with OCD, however, and there is evidence of etiological (causal) overlap between the two disorders. Nevertheless, HD occurs independently of OCD in 60-80% of cases, these disorders have different epidemiological (health patterns) and neurocognitive profiles, and most importantly, different treatment outcomes.

### **Epidemiology of HD compared to OCD**

Prevalence rates of OCD are fairly stable across the lifespan, affecting approximately 2% of children, adolescents, and adults. The age of onset varies, but for many, symptoms begin in childhood or early adolescence. Symptoms of OCD wax and wane with time, but tend to become problematic and/or distressing relatively soon after onset, and without treatment, continue at fairly consistent levels into old age.

Unlike OCD, HD appears to be a progressive disorder. The overall prevalence of HD is between 2 and 4%, increasing to over 6% in individuals age 55 and older. Rather than waxing and waning, hoarding symptoms tend to be chronic and slowly increase over time. While the age of onset for hoarding symptoms is similar to that of OCD (ages 12-15), these symptoms do not initially cause impairment or distress, but typically become problematic later in life, usually around the 4th or 5th decades. This

progression of severity may be in part due to parental or other influences (e.g., spouse, roommate) that require or assist individuals to discard items, preventing the accumulation of clutter.

### **Insight into illness/help-seeking**

Most individuals with OCD have good insight into their illness, recognizing that their obsessions and compulsions are not logical, although they may or may not recognize that their symptoms are due to OCD. Symptoms are ego-dystonic except in children, where, depending on developmental stage, symptoms may be ego-syntonic. In contrast, hoarding, while distressing, is often not completely ego-dystonic, and insight into illness is quite variable. Individuals with HD may be distressed by their hoarding, but may not be able to recognize the cause as being due to an inherent difficulty in discarding or to excessive acquiring of un-needed objects, despite clear evidence of this, citing instead external causes such as limited space, difficulties with organization, or the possibility that the items may be at some point needed and will not be obtainable at that future point. Poor or variable insight and lack of ego-dystonicity of symptoms can lead to reluctance to seek help, and possibly also to poor response to treatment.

### **Neurocognition in HD**

Although the core feature of HD is difficulty discarding unnecessary and/or useless items, there is a growing body of evidence to suggest that this difficulty is due to an even more fundamental deficit of executive function. Although somewhat inconsistent due to methodological differences and small sample sizes, neuropsychological and electrophysiological studies of HD have identified deficits in categorization, working memory, decision making, attention, and error processing, and there is emerging data to suggest that deficits in memory and learning, particularly in the visual domain, are also seen in individuals with HD.

Perhaps more directly relevant for clinicians, a history of childhood attention deficit hyperactivity disorder (ADHD), in particular, the inattentive subtype, has been associated with HD in a number of studies(9), providing indirect evidence that executive dysfunction may predate the onset of hoarding symptoms, and also suggesting that pharmacotherapy for ADHD (e.g., stimulants, bupropion, atomoxetine) may be of benefit in HD.

### **Pharmacologic treatment of HD**

The treatment of HD has for the most part been based on and modified from current treatment strategies for OCD, and most of the focus has been on behavioral approaches. The most commonly used pharmacotherapeutic options currently include the selective serotonin reuptake inhibitors (SSRIs) and the serotonin-norepinephrine reuptake inhibitors (SNRIs), although other agents such as stimulants have been tried in a very small number of individuals. Unfortunately, however, very little is known about the efficacy of pharmacotherapy in HD; most of the studies that do exist examine the relationship between treatment response and symptom subtypes, including hoarding, in individuals with a primary diagnosis of OCD. These studies have been mixed, with some suggesting that individuals with prominent hoarding symptoms tend to have a worse treatment response to SSRIs than do those without prominent hoarding symptoms, and others indicating that the treatment response is similar with and without hoarding. To date, there have been no blinded, placebo-controlled studies of treatment response in HD, and only two open-label studies. The first was an open-label trial of paroxetine in 32 individuals with HD and 47 with non-hoarding OCD, and the second was a trial of extended release venlafaxine. In contrast to the studies of hoarding as an OCD subtype, which suggested that individuals with hoarding symptoms had poorer responses to SSRIs, the paroxetine study showed a similar response rate for individuals with HD and those with nonhoarding OCD (approximately 50% had at least a partial response, defined as a  $\geq 25\%$

improvement in symptoms) on 40-60 mg of paroxetine per day. However, a substantial number of individuals from both groups were unable to tolerate the target dose of 40 mg a day, and only 16 were able to tolerate the full dose of 60 mg per day, somewhat limiting the interpretability of the results. This group also reported on an open label trial of extended release venlafaxine. In this trial, which examined 24 individuals with HD (no control group was included), sixteen of the 23 who completed treatment were classified as treatment responders, with a  $\geq 30\%$  improvement in hoarding symptoms. The mean final dose for these individuals was about 200 mg per day—only sixteen were able to tolerate a dose of 225 mg per day. Although somewhat contradictory to the early studies showing poorer treatment response among individuals with OCD + hoarding symptoms, and limited by small sample sizes and open-label designs, these studies provide some hope that pharmacotherapy with SSRIs and/or SNRIs have a role in the treatment of HD. Importantly, however, recent studies examining willingness to undergo treatment suggest that individuals with HD or OCD-related hoarding are less willing than individuals with non-hoarding OCD to take medication for their symptoms, although they may be willing to participate in behavioral therapy. This reluctance may in part be related to the problems with insight discussed above, or it may be due to the fact that HD has only recently been recognized as a psychiatric disorder with clear biological underpinnings, and thus a medical model approach may not feel appropriate for affected individuals.

### **Psychotherapy for HD**

In contrast to pharmacotherapy, there is a reasonably sized literature on psychotherapy for HD. As with medication treatment, behavioral treatment for HD is based on the standard of care for OCD, and has been modified over time to more specifically address the unique challenges faced by individuals with HD. The core component of psychotherapy for HD is cognitive behavioral therapy (CBT); components on motivational interviewing and harm reduction are also common. The cognitive component typically focuses on addressing cognitive distortions related to fear of discarding and urges to acquire, while the behavioral component focuses on sorting through and discarding materials in a systematic and structured way, either in the therapy session or at home. CBT can be administered either in a group setting or in individual treatment. Home visits by the clinician are incorporated into most behavioral treatments for HD, primarily to provide an accurate assessment of functional impairment in the context of limited insight, but also to assess progress and if needed, to assist with further tailoring of the behavioral intervention. Motivational interviewing has become a key component of behavioral interventions for HD, aimed at decreasing ambivalence for treatment by helping patients identify areas of impairment that they recognize to be caused by hoarding symptoms, and that they wish to improve (e.g., social relationships impaired by not being able to let family members or friends into the home, safety issues related to piles on the floor or on surfaces, etc). Harm reduction is similar in concept to motivational interviewing, and the aim of this component is not to cure the hoarding problem, but to reduce the impairment (harm) caused by the symptoms and thus improve quality of life for the affected individual.

More recently, a form of behavioral therapy led by peers rather than by mental health providers, called peer-facilitated support group therapy, has been developed. This approach uses the same CBT concepts used in standard group treatment, and is based on working through the exercises laid out in a self-help manual called *Buried in Treasures*. Peer-facilitated support groups are meant to provide a more supportive and potentially less stigmatizing environment than CBT groups led by mental health providers, as the group leaders typically have lived experience of problematic hoarding, and, in addition to meeting on a weekly basis in a group format, call participants prior to each group to check in and encourage them to attend the following group session.

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Although there are as yet no studies that directly compare peer-facilitated support group treatment to group CBT led by a mental health provider, the mean response rates for published studies, including individual CBT, group CBT, and peer-facilitated support group treatment, are between 12 and 14 points improvement (range 7.5 to 18.5) on the Savings Inventory-Revised (SI-R), a self-report assessment of hoarding symptoms. As most treatment studies reported mean pre-treatment scores of  $\geq 60$  (a score of  $\geq 42$  is typically used as the cutoff for clinically significant hoarding), a 14-point improvement represents at best a 23% improvement over baseline. Thus, while comparable to the commonly used definition of treatment response in OCD ( $\geq 25$ -35% improvement in Yale Brown Obsessive Compulsive Scale or YBOCS severity score), it is clear that, although perhaps more tolerable to participants, currently-available behavioral treatments rarely, if ever, result in remission of symptoms, and improvements are modest for most individuals.

Clearly, more work is needed to identify effective treatments for HD, both pharmacologic and psychotherapeutic. Given the relatively poor response rates for currently available treatments ( $\leq 30\%$  improvement of symptoms) and evidence of potential underlying neurocognitive deficits, new avenues for treatments might include cognitive remediation in addition to medication and therapy and/or medications that target executive dysfunction (anticholinesterase inhibitors, stimulants, etc).

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### Appendix B

#### *Memorization Flashcards*

**(1)**

**A:** What are typical symptoms of HD?

**B:** A desire to save and difficulty or indecision discarding items.

**(2)**

**A:** What hoarding behaviors are exhibited by people with neuropsychiatric disorders other than HD?

**B:** Collecting rubbish.

**(3)**

**A:** How does the severity of HD symptoms progress over time?

**B:** Symptoms of HD grow progressively stronger throughout the lifetime.

**(4)**

**A:** How does the incidence of HD progress over time?

**B:** Incidence rates of HD increase progressively throughout the lifetime.

**(5)**

**A:** What is the incidence rate of OCD in adulthood?

**B:** 2%.

**(6)**

**A:** What is the incidence rate of HD in adulthood?

**B:** 6%.

**(7)**

**A:** How do people with HD perceive the stress caused from their compulsion?

**B:** People with HD experience distress resulting from their disorder, but often do not understand that the hoarding behavior is the source of their stress.

**(8)**

**A:** How do people with HD perceive their behavior?

**B:** People with HD view their behavior as rational.

**(9)**

**A:** How does the value of an item contribute to hoarding behavior?

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**B:** HD patients place value not related to money on an item in order to justify keeping that item.

**(10)**

**A:** What is a cause of the core features of HD?

**B:** A deficit in executive function.

**(11)**

**A:** What characterizes a deficit in executive function?

**B:** The inability to accurately categorize stimuli, make good decisions, and process errors.

**(12)**

**A:** What are common pharmacological approaches to treating OCD?

**B:** SSRI medications and SNRI medications

**(13)**

**A:** How do people with OCD respond to treatment using SSRI medications?

**B:** People with OCD show partial improvement in symptoms when using SSRI medications.

**(14)**

**A:** How do people with OCD and hoarding tendencies respond to treatment using SSRI medications?

**B:** People with OCD and hoarding tendencies do not show improvement while using SSRI medications.

**(15)**

**A:** What type of treatment are people with HD sometimes unwilling to complete?

**B:** Pharmacotherapy

**(16)**

**A:** How does motivational interviewing help people with HD?

**B:** Motivational interviewing helps people with HD identify areas of impairment and how other treatments can successfully improve HD symptoms.

**(17)**

**A:** Harm reduction therapy results in:

**B:** Reduced impairment caused by the symptoms of HD, and improved quality of life.

**(18)**

**A:** How effective is the rate of improvement for people with HD who complete individual CBT, group CBT, and peer-facilitated group therapy?

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**B:** Approximately 23%

**(19)**

**A:** How effective is psychotherapy at eliminating HD symptoms?

**B:** Psychotherapy usually does not result in the complete elimination of symptoms.

**(20)**

**A:** Future avenues of treatment are expected to:

**B:** Combine pharmacological and psychotherapeutic agents to improve HD symptoms.

Appendix C

*Elaboration Flashcards*

**(1)**

**A:** What are typical symptoms of HD?

**B:** A desire to save and difficulty or indecision discarding items.

**Ex:** For example, if a person with HD received a pair of shoes that did not fit, that individual would be inclined to store that pair of shoes.

**Ex:** For example, if a person with HD had a pair of shoes that no longer fit, that individual would have difficulty giving away or disposing of those shoes.

**(2)**

**A:** What hoarding behaviors are exhibited by people with neuropsychiatric disorders other than HD?

**B:** Collecting rubbish.

**Ex:** For example, a person with schizophrenia may be compelled to store an empty water bottle.

**(3)**

**A:** How does the severity of HD symptoms progress over time?

**B:** Symptoms of HD grow progressively stronger throughout the lifetime.

**Ex:** For example, the compulsion to hoard items is generally much stronger as an adult than it was in childhood.

**(4)**

**A:** How does the incidence of HD progress over time?

**B:** Incidence rates of HD increase progressively throughout the lifetime.

**Ex:** For example, more adults are more often diagnosed with HD than children.

**(5)**

**A:** What is the incidence rate of OCD in adulthood?

**B:** 2%.

**Ex:** For example, 2 of 100 adults are diagnosed with OCD.

**(6)**

**A:** What is the incidence rate of HD in adulthood?

**B:** 6%.

**Ex:** For example, 6 of 100 adults are diagnosed with HD.

## EFFECTS OF STUDY TIME AND LEVELS OF PROCESSING ON TEST PERFORMANCE

**(7)**

**A:** How do people with HD perceive the stress caused from their compulsion?

**B:** People with HD experience distress resulting from their disorder, but often do not understand that the hoarding behavior is the source of their stress.

**Ex:** For example, a person with HD may be stressed from having too little space, but may blame this stress on the house being too small rather than blaming their hoarding compulsions.

**(8)**

**A:** How do people with HD perceive their behavior?

**B:** People with HD view their behavior as rational.

**Ex:** For example, a person with HD that saves their old shoes may believe their compulsive behaviors are necessary and normal.

**(9)**

**A:** How does the value of an item contribute to hoarding behavior?

**B:** HD patients place value not related to money on an item in order to justify keeping that item.

**Ex:** For example, an HD patient may justify keeping a pair of shoes that no longer fit by saying the shoes bring back fond memories.

**(10)**

**A:** What is a cause of the core features of HD?

**B:** A deficit in executive function.

**Ex:** For example, a person with HD may not be capable of understand why shoes that no longer fit do not need to be saved.

**(11)**

**A:** What characterizes a deficit in executive function?

**B:** The inability to accurately categorize stimuli, make good decisions, and process errors.

**Ex:** For example, a person with HD may not be able decide what to do with shoes that no longer fit.

**(12)**

**A:** What are common pharmacological approaches to treating OCD?

**B:** SSRI medications and SNRI medications

**Ex:** For example, a person with OCD may be prescribed SSRI or SNRI medication to alleviate symptoms.

## EFFECTS OF STUDY TIME AND LEVELS OF PROCESSING ON TEST PERFORMANCE

**(13)**

**A:** How do people with OCD respond to treatment using SSRI medications?

**B:** People with OCD show partial improvement in symptoms when using SSRI medications.

**Ex:** For example, a person with OCD using SSRI medication may be less affected by their compulsions.

**(14)**

**A:** How do people with OCD and hoarding tendencies respond to treatment using SSRI medications?

**B:** People with OCD and hoarding tendencies do not show improvement while using SSRI medications.

**Ex:** For example, a person with OCD and hoarding tendencies using SSRI medications may still exhibit hoarding behaviors.

**(15)**

**A:** What type of treatment are people with HD sometimes unwilling to complete?

**B:** Pharmacotherapy

**Ex:** For example, a person with HD may accept behavioral treatment, but may not believe their condition requires medication.

**(16)**

**A:** How does motivational interviewing help people with HD?

**B:** Motivational interviewing helps people with HD identify areas of impairment and how other treatments can successfully improve HD symptoms.

**Ex:** For example, motivational interviewing may help a person with HD gain the desire to follow their treatment plan.

**(17)**

**A:** Harm reduction therapy results in:

**B:** Reduced impairment caused by the symptoms of HD, and improved quality of life.

**Ex:** For example, a person with HD that undergoes harm reduction therapy may be less stressed as a result of their compulsive tendencies.

**(18)**

**A:** How effective is the rate of improvement for people with HD who complete individual CBT, group CBT, and peer-facilitated group therapy?

**B:** Approximately 23%

## EFFECTS OF STUDY TIME AND LEVELS OF PROCESSING ON TEST PERFORMANCE

**Ex:** For example, a person with HD that undergoes individual CBT, group CBT, or peer-facilitated group therapy is likely to show a 23% improvement in their condition.

**(19)**

**A:** How effective is psychotherapy at eliminating HD symptoms?

**B:** Psychotherapy usually does not result in the complete elimination of symptoms.

**Ex:** For example, a person with HD that completes therapy can improve in their condition, but will still experience abnormal compulsions.

**(20)**

**A:** Future avenues of treatment are expected to:

**B:** Combine pharmacological and psychotherapeutic agents to improve HD symptoms.

**Ex:** For example, people with HD in the future are expected to be prescribed a combination of medication and therapeutic treatments.

EFFECTS OF STUDY TIME AND LEVELS OF PROCESSING ON TEST PERFORMANCE

Appendix D

*Distraction Task*

DEMOGRAPHICS

Gender (Please select one)    Male    Female    Do not wish to indicate

Ethnicity (Please select all that apply)

White    Asian    African American    Middle Eastern    Hispanic    Native American

Other \_\_\_\_\_    Do not wish to indicate

Grade Level (Please select one)

Freshman    Sophomore    Junior    Senior    Graduate

Age \_\_\_\_\_

DISTRACTOR QUESTIONS

Major \_\_\_\_\_

Desired Profession \_\_\_\_\_

Reason for participating \_\_\_\_\_  
\_\_\_\_\_

High school graduation year \_\_\_\_\_

Favorite high school class \_\_\_\_\_

Religious Orientation \_\_\_\_\_

Political orientation

Democrat    Republican    Socialist    Other \_\_\_\_\_

## EFFECTS OF STUDY TIME AND LEVELS OF PROCESSING ON TEST PERFORMANCE

### Appendix E

#### Test

(1)Question: What symptoms are commonly exhibited in people with hoarding disorder (HD)?

- a) People with HD have a strong desire to save new items and face difficulty discarding already possessed items.
- b) People with HD often collect rubbish.
- c) Both A and B are correct.
- d) None of the above are symptoms of HD.

(2)Question: What hoarding behavior(s) are not typical in hoarding disorder (HD)?

- a) The collecting of rubbish.
- b) Distress or indecision associated with discarding items.
- c) Both A and B are hoarding behaviors typical in HD.
- d) None of the above are correct.

3)Question: How are the incidence and symptoms of hoarding disorder (HD) exhibited over a lifetime?

- a) The incidence and severity of HD symptoms typically remain consistent throughout the lifetime.
- b) The incidence and severity of HD symptoms grow progressively throughout the lifetime.
- c) The incidence and severity of HD symptoms weaken throughout the lifetime.
- d) The incidence of HD remains stable while the severity of symptoms wax and wane throughout the lifetime.

(4)Question: What are the incidence rates for adults with obsessive compulsive disorder (OCD) and hoarding disorder (HD)?

- a) HD=2%, OCD=6%
- b) OCD=2%, HD=6%
- c) OCD=2%, HD=2%
- d) HD=6%, OCD=6%

(5)Question: How do people with hoarding disorder (HD) perceive their compulsions?

- a) People with HD typically understand their compulsions are illogical.
- b) People with HD typically perceive their compulsions to be the source of their distress.
- c) Both A and B are both correct.

## EFFECTS OF STUDY TIME AND LEVELS OF PROCESSING ON TEST PERFORMANCE

d) None of the above are correct.

(6)Question: How are people with hoarding disorder (HD) able to rationalize their behavior?

a) HD patients are able to place value not related to money on the items they want to keep.

b) The items typically saved by HD patients are typically high in monetary value.

c) The items typically saved by HD patients are often rare and difficult to find.

d) None of the above are correct.

(7)Question: What is not a possible cause of hoarding disorder (HD) symptoms?

a) A deficit in executive function.

b) Deficits in the ability to categorize stimuli, make good decisions, and process errors.

c) Attention deficit hyperactivity disorder (ADHD)

d) None of the above are correct.

(8)Question: What cognitive function is not impaired in people with hoarding disorder (HD)?

a) The ability to accurately categorize stimuli.

b) An adequate attention span.

c) Good decision making ability.

d) Long term memory retention.

(9)Question: Do people obsessive compulsive disorder (OCD) respond better to SSRI medications or SNRI medications?

a) People with OCD and hoarding tendencies respond better to SSRIs.

b) People with OCD respond similarly to SSRIs and SNRIs.

c) Both A and B are correct.

d) None of the above are correct.

(10)Question: What type of therapy is most likely to be opposed by people with hoarding disorder (HD)?

a) Group cognitive behavioral therapy (CBT)

b) Individual cognitive behavioral therapy

c) Pharmacotherapy

d) Psychotherapy

(11)Question: What treatment method is not directly concerned with treating symptoms of hoarding disorder (HD)?

## EFFECTS OF STUDY TIME AND LEVELS OF PROCESSING ON TEST PERFORMANCE

- a) Motivational interviewing
- b) Harm reduction
- c) Pharmacotherapy
- d) None of the above are correct.

(12)Question: Harm reduction therapy:

- a) Reduces impairment in hoarding disorder (HD) patients.
- b) Improves the quality of life for people with HD and obsessive compulsive disorder (OCD).
- c) Reduces impairment in people with OCD.
- d) All of the above are correct.

(13)Question: What form of psychotherapy is most effective for treating hoarding disorder (HD)?

- a) Individual cognitive behavioral therapy (CBT)
- b) Group CBT
- c) Peer-facilitated group therapy
- d) All are equally effective at treating HD.

(14)Question: How are treatments for neuropsychiatric disorders expected to change in the future?

- a) Pharmacological treatment will be more advanced, and most beneficial to patients with neuropsychiatric disorders.
- b) Pharmacotherapy treatments will be used in combination with psychotherapy treatments.
- c) The increased effectiveness of pharmacological approaches are expected to render psychotherapy approaches obsolete.
- d) None of the above are correct.