Effectiveness of Study Strategies: A Comparison of Two Study Methods

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Effectiveness of Study Strategies: A Comparison of Two Study Methods

The present study is designed to investigate the relationship between working memory and study methods. Specifically it is looking at the differences in students with higher and lower working memory by comparing the test performances based on using the SOAR and read-recite-review study methods. A significant difference between test scores could indicate a study skill that could be taught to individuals who struggle in school due to lower natural ability.

**Intelligence**

Spinks et al. (2007), while conducting a longitudinal study on the predictive ability of childhood school achievement, found that elementary school achievement is correlated to adult IQ, occupational status, and household income in mid life. This research seems to support the idea that school achievement is relatively stable across time and can significantly affect a person’s later life. Research by Colom and Flores-Mendoza (2007) and Deary, Strand, Smith, and Fernandes (2007) has also shown that general intelligence in childhood is able to predict scholastic achievement over time. These findings support the idea that academic achievement is not what humans can learn, but rather how they can learn.

Much research has focused on how general intelligence, fluid intelligence, and crystallized intelligence may predict academic performance. Crystallized intelligence is the measure of accumulated knowledge, fluid intelligence is the measure for abstract problem solving ability, and general intelligence (g) is the combination of the two. While research began with testing the impact of general intelligence on academic performance, researchers have also begun to look at the individual aspects of intelligence as well. Colom and Flores-Mendoza (2007) have shown that fluid intelligence and crystallized intelligence are both significantly correlated to scholastic achievement. Crystallized intelligence would demonstrate the amount of
information that had been learned, but the variance due to fluid intelligence focused more on the participants’ natural ability to learn.

One aspect of fluid intelligence, working memory, has also been linked to academic achievement throughout research. Working memory is the active processing of incoming information, some of which is stored into long-term memory (Myers, 2007). A study in Beijing showed that both general intelligence and working memory were positively correlated with academic achievement in Chinese and math tests; however it was the interaction between general intelligence and working memory that accounted for most of the variance between students (Lu, Weber, Spinath, & Shi, 2011). Since both general intelligence and working memory accounted for differing levels of variance it appears that while similar these two measures of intelligence focus on different aspects of learning. Had working memory accounted for only a portion of the variance that was also accounted for by general intelligence then it could be concluded that working memory is only a subsection of general intelligence and does not measure anything that is not also measured by general intelligence. However, this was not the case; there was variance within working memory that is correlated to, but not due to general intelligence. This variance may be due to another factor such as reaction time that is often included in working memory measures, but not general intelligence measures. By using both Chinese and math performance the researchers were able to investigate whether the context of the material caused a difference in whether general intelligence or working memory had a larger role. As researchers expected, general intelligence was more highly correlated with Chinese scores and working memory was more highly correlated with math scores (Lu, Weber, Spinath, & Shi, 2011). This is due to the type of information that was required for success in the subjects. The Chinese test likely requires memorization of at least 2,000 characters throughout the child’s life while the math only requires
memorization of a few symbols and tests the usage of the symbols. In both of these tasks students were asked to apply a rule that needed to be learned.

Some research is not as supportive of the idea that general intelligence is the best predictor of performance. Bühner, Kröner, and Ziegler (2008) found that working memory may be the best predictor with undergraduate students. In this research students first learned a rule and then were asked to apply the rule in non-optimal situations. The students were then scored based on their knowledge of the rule and their ability to apply the rule correctly in other situations. By factoring out working memory from general intelligence, the findings show that variance is due more specifically to the working memory rather than general intelligence as a whole. This finding should not be surprising as fluid intelligence and working memory focus more on further developing abstract reasoning skills rather than accumulating knowledge. This difference in research findings is likely due to the type of task that was required from participants, the tasks that required accumulated knowledge would have a higher variance due to general or even crystallized intelligence and tasks requiring rule application would have a higher variance due to fluid intelligence or working memory.

The role of working memory in achievement has also been a major area of research. Working memory can be split into four major areas: the central executive, phonological loop, visuo-spatial sketch pad, and episodic buffer (Ashcraft & Radvansky, 2010). The episodic buffer begins to integrate information as it is sent to the central executive. The central executive can be thought of as the switch board within working memory; it decides what information to focus on, what information to ignore, and what information to encode for long-term memory. The visuo-spatial sketch pad and the phonological loop are both involved with the rehearsal of visual and auditory information and they send information back to the central executive for further
integration. Altogether they help focus on immediate information, rehearse that information, and integrate some of it into long-term memory. Previous research seems to show that people who score higher on working memory tasks have better control over their stream of thought and are less distracted by distracting information than people who score lower on working memory tasks (Ashcraft & Radvansky, 2010). It may be that this distraction causes people who score lower on working memory tasks to lose the important information amongst all the other information.

With this in mind, it is possible that ability to remember the necessary information may increase by putting an extra focus on the important information. In other words, it may facilitate learning to teach ways to focus on important information and to ignore other information.

**Empirically Effective Study Methods**

Many investigators have focused on which study strategies are most utilized by college students, but there is a subset of research that focuses on investigating particular study methods. Two of the study methods found to be advantageous for college students are the read-recite-review study strategy and the selection-organization-association-regulation study method (McDaniel, Howard, & Einstein, 2009; Jairam & Kiewra, 2009). While both of these study methods are empirically supported, they do employ different strategies for learning information.

The read-recite-review (3R) method appears to focus on memorization of concepts and definitions. The 3R is essentially the idea that reading and then rereading material will better help students learn the information. This method helps students to initially find how much they can memorize without trying and then allows the students to check just how much they were able to remember. By using this study method students would read information (a paragraph), recite aloud as much information as possible, and then reread the information to check how much was initially remembered and to give extra attention to information that was previously forgotten.
This seems to be very similar to the reading and note-taking methods typically used by college students. Both methods encourage recitation or memorization of information. In a study by McDaniel, Howard, and Einstein (2009) this study strategy was found to be more advantageous than the typical note-taking and rereading strategies that students typically utilize with free-recall questions and more advantageous than rereading with multiple-choice questions and problem solving. Based on this study it appears that this study method also has some long-term retention over time as well, with participants showing better performance on the multiple-choice questions a week after the information was initially learned (McDaniel, Howard, & Einstein, 2009). It seems that this study method can elicit better academic performance than note-taking and rereading information, but there is no indication as to how it would fare being compared to a study method that focuses on selecting ideas and organizing information (using critical thinking).

The selection-organization-association-regulation (SOAR) method however, focuses on organizing information and making inferences and connections between the information for better storage and retrieval. The SOAR method consists of four processes: select, organize, associate, and regulate (Jairam & Kiewra, 2009). First, students must select the main ideas and relevant information from the material that was read. Next they must organize this material utilizing graphic organizers and then link the information together (associate). Finally, students must self-test to practice critical thinking skills and to test the information learned. The SOAR method is also based on the assumption that students’ note-taking and study strategies are severely lacking. With the SOAR study strategy there are varying levels that can be used based on the type of information that needs to be learned. In a study by Jairam and Kiewra (2009) it appears that utilizing both selection and organization was the most effective strategy when required to recall facts, but when required to form relationships with the information the full
selection, organization, association, and regulation (SOAR) strategy was the most effective. Based on these findings it appears that the SOAR method, if correctly implemented, would be beneficial for college students, who are often required to use critical thinking.

**Study Strategies of High Achievers**

Study skills are the ways that a person acquires and integrates information into their existing knowledge base. The use of study strategies has a large impact on the success rate of students. While much research has been conducted based on what study strategies students employ, the differences between strategies utilized by high and low academic achievers, and in-depth studies of strategies, very little research has been conducted taking cognitive reasoning into account as well. Much of the focus of research ignores that intelligence plays a role in whether or not a child succeeds in school or whether that child struggles. There is the possibility that the high academic achievers have a higher working memory or higher general intelligence and are therefore able to learn the material easier regardless of the study strategies that are employed.

The Learning and Study Strategies Inventory (LASSI) by Weistein, Schulte, and Palmer (1987) is a frequently used research measure concerning study strategies students utilize, followed by the revised version LASSI-2 (Proctor, Hurst, Prevatt, Petscher, & Adams, 2006; Yip, 2009). This inventory includes items such as motivation, use of study aides, selecting main ideas, motivation, anxiety, and concentration. This measure is primarily based on student’s responses in a retrospective questionnaire and does not take into consideration how effectively the participant uses the methods. A study by Ning and Downing (2010) utilized the LASSI to find evidence that the learning experience and the study behaviors have a reciprocal relationship. The study behavior affects students’ academic performance and the performance then influences
the study strategy that is utilized in the future. Based on this finding it appears that study strategies are a learned behavior based almost entirely on previous experience with similar material and knowledge of effective and ineffective strategies for them.

It is no secret that study habits and time spent studying play a role on academic performance. Yip (2009) found that study strategies and academic performance were significantly related, the students with higher academic achievement scored higher on information processing, test strategies, self-testing, selecting main idea, concentration, anxiety, attitude, and motivation than the students with low academic achievement. Those who scored higher elaborated more, were better prepared to organize and relate material to each other, utilized more test preparation strategies, tested themselves on the material to find how much they know, found the critical information from the material, paid better attention, had a better attitude about their achievements, worried more about their performance, and were more diligent. Since those with higher academic achievement better organize and select information it would be reasonable to assume that those with higher intelligence would automatically select and organize information in a way similar to the SOAR method. Of these strategies self-testing, selecting main ideas, and organization are all aspects of the SOAR method, while the 3R method only utilizes the concentration and self-testing study methods. With this in mind the SOAR method seems to teach critical thinking while the 3R method seems to focus on strategies for memorization.

One drawback of the LASSI and the LASSI-2 is that the context of the learned information and the implementation of the strategy are not taken into consideration. These questionnaires simply ask students about typical study strategies used. Researchers have found that while students appear to have specific study styles, these change based on the context of the
material (Hadwin, Winne, Stockley, Nesbit, & Woszczyna, 2001). For instance, a student reading to learn information (e.g. reading text before a lecture) would utilize different study strategies than when he or she is writing an essay or preparing for a final exam. For the essay the student may spend more time in the preparation stage, may utilize more resources, and integrating ideas. For the exam the student may spend more time selecting and rehearsing information, planning responses to probable questions, may utilize more personal resources (such as notes), may use surface selection or depth selection, and may memorize information. As can be seen there are different processes and ways to learn or gather the information based on the task. Ross, Green, Salisbury-Glennon, and Tollefson (2006) support this research finding that the type of content, essay or multiple-choice questions and deep-level or surface-level cognition, expected on an exam influenced the study strategies utilized for the exam as well as how students performed on an exam.

Both of these studies indicate that context highly influences which study strategies are utilized. Based on these two studies it appears that academic expectations play a major role in which study strategies are utilized. Motivation plays a major role in which study strategy students employ and consequently the effectiveness of that studying. Students wanting to obtain an A on a deep-level cognition essay exam will implement different strategies than a student just trying to do well enough to pass.

As seen by Proctor, et al. (2006) students with slight learning disabilities and students who are struggling in school implement different study strategies. It would seem natural that the students that have higher academic success would have learned better study strategies along the way than the students with poor academic performance. Proctor, et al. (2006) found that students that were clinically referred (students who were referred to the campus clinic to be tested for a
learning disorder) and had low GPAs showed weakness in study skills including anxiety, concentration, motivation, selecting main ideas, and testing strategies. These findings show that there are differences in the study skills between academically struggling groups and higher achieving peers. With this in mind it could be safe to assume that students with lower intelligence scores implement different study strategies than students with higher intelligence scores. Is it possible for the students with lower academic performance to be taught study strategies to make up for their failure to select relevant information? It may be that those students simply do not know how to study for exams, other than reviewing textbook material.

All of the research found highlights the differences between low and higher academic achievers based on study methods used. Since the working memory portion of general intelligence has so much influence in the classroom it would seem to also have an influence on which study method is utilized. It could be that working memory influences the study method used, but at the same time, working memory could affect the effectiveness of the study method. Of the study strategies that are being taught to students the SOAR method is the only one that focuses in on concept processing. This is why it is believed that the SOAR method may be able to have a positive influence on working memory and thus academic performance. If this is the case then the subset of students that generally struggle in school systems may be taught strategies to facilitate learning.

**Hypotheses**

This experiment explores the effectiveness of two different study strategies, whether there are differences in the effectiveness of study strategies based on working memory, and whether the SOAR method can be used to counterbalance lower working memory. It is expected that participants with lower working memory scores using the SOAR method would perform
better than participants with lower working memory scores using the 3R method. Since both of these study strategies have been shown to be correlated with academic success it is expected that students with higher working memory would perform the same regardless of which study strategy exposure. It is expected the participants with lower working memory will perform better using the SOAR method than the participants with lower working memory using the read-recite-review method because the SOAR method requires the participants to select and organize the main ideas and to find relationships within the information, a skill that academically struggling students have been found to be lacking and a skill that may not be fully developed in individuals with lower working memory.

Method

Participants

Participants consisted of 89 people obtained through the Marietta College undergraduate research participant pool and other Marietta College students recruited from interest in recruitment posters that were placed throughout campus as well as through interest when the research was mentioned during psychology classes. Three participants did not complete the study method correctly and therefore only the data from 86 participants was analyzed. The participants consisted on 35 males and 51 females. They ranged in age from 17 to 26. Participant demographic information can be viewed in Table 1. Any students that signed up for the research study were given 1 hour credit towards research requirements. Participants with the top 20 highest total quiz scores were entered into a drawing for 2 $25 gift cards. After signing an informed consent participants were randomly assigned into one of two groups: SOAR study method or 3R study method.
Materials and Procedure

After random assignment into a study method the participants were given a demographic questionnaire to complete measuring gender, age, and year in college (see Appendix A.) After that participants’ working memory was assessed using an automated operation span task that has been shown to be a reliable and valid measure of working memory (Unsworth, Heitz, Schrock, & Engle, 2005). Developed by Unsworth, Heitz, Schrock, and Engle (2005) the automated operation task is a computer program that measures working memory by analyzing percentage of correct math answers, percentage of correct letter sequence answers, and the time needed to answer questions. The automated operation span task presents the participant with the task of answering simple math problems followed by memorizing a string of letters. The automated operation span task is significantly correlated to the manual operation span task (Turner & Engle, 1989), the Raven Progressive Matrices (Raven, Raven, & Court, 1998), and the Reading Span Task (Daneman & Carpenter, 1980) which have all previously been the standards for measuring working memory (Unsworth, Heitz, Schrock, & Engle, 2005).

In the automated operation span task the participant was presented three practice sections to familiarize themselves to the task. The first required participants to memorize a string of letters and then select them from a 4 x 3 letter matrix in the correct order. Next, participants were presented a simple math problem (such as 6/3 + 2) and were asked to click on the screen as soon as they knew the answer. The next screen showed an answer and the participant clicked on either a true or false option signifying whether or not they believed that answer was the correct answer. The third practice section both of the tasks were put together. The participants had to solve several math problems and after each answer was chosen for the math problem, were given a letter to memorize. After several the participants were told to use the letter matrix to put the
memorized letters in the correct order. After the three practice sections each participant would do the actual operation span task on the computer, by solving the math problems and entering the string of letters back into the computer. The number of letters to memorize at one time ranged from 3 to 7.

After completing the automated operation span task participants were taught a study method and then asked to demonstrate that method while reading three essays and taking a quiz over each essay. Those in the SOAR study method group were then taught how to select and organize information into a chart as it is read. Since the test requires fact recall only the selection and organization sections of the SOAR were utilized instead of the full SOAR. Participants in this group were shown an example of information on wildcats and a table demonstrating how this information was organized into a table to better compare information. After confirming that participants had no further questions they were given an essay containing information on the inner planets in our solar system. (See Appendix B.) Participants then read the information and then used a provided study sheet to study the information. (See Appendix C.) This segment took no more than 10 minutes to complete. Finally the participants were given a 10 question quiz on the information provided requiring factual recall and some sequencing information comparing the planets. (See Appendix D.) This process was then followed by an essay (see Appendix E), study sheet (see Appendix F), and quiz (see Appendix G) on wars that the United States has been involved in and then an essay (see Appendix H), study sheet (see Appendix I), and a quiz (see Appendix J) on scientists that influenced the field of psychology.

Participants in the 3R study method were taught that they needed to read information a paragraph at a time, recite back as much information as possible, and then reread the paragraph paying special attention to information that was not recited. The same wildcat example was used
for this group with the researcher first demonstrating how to read, recite, and review the information. The study sessions were listened in on to ensure that participants used the assigned study method, the study sheets that participants in the SOAR group used were collected to ensure that the correct information was studied. These participants were also encouraged to ask any questions concerning how to use the study method and afterwards were given the same inner planets essay, followed by the 10 question quiz, war essay, followed by the 10 question quiz, and scientist essay, followed by a 10 question quiz.

After each research session the quizzes were scored and any study sheet was analyzed for compliance to the method. The participants were then given scores based on the number of correct answers on each quiz that were then used for comparing the group performance. Any participants who did not fill in the study sheet with the correct information and any participant in the 3R group that did not complete the study strategy aloud were marked as using the study method incorrectly and their data was not analyzed. Altogether participants were compared based on study method, but within each study method they were also compared based on working memory ability.

**Results**

Using a Univariate Analysis of Variance a significant difference was found on total quiz scores based on the study method used, $F(2,85) = 155.29, p < .001$. The participants who used the SOAR study method ($M = 21.19$, $SE = 0.58$) scored significantly higher on the quizzes than the participants who used the 3R study method ($M = 20.78$, $SE = 0.62$) as can be seen in Graph 1. While there was a significant effect of study method type on quiz scores, working memory (as measured through the automated operation span task’s Ospan Absolute Score) did not have a significant effect on quiz scores, $F(1,85) = .02, p = .89$. The Ospan Absolute Score was not a
predictor of quiz score as was expected. There was also no interaction between study method and Ospan Absolute Score, $F(1,85) = .04, p = .84$, contrary to the hypothesis. To further explore factors that may have an impact on quiz scores the relationships that gender, year in college, and method order (completing the working memory task first versus completing the study method first) have with quiz score were also analyzed. There was a significant relationship between year in college and total quiz score, $F(1, 81) = 5.33, p = .02$. Upon further analysis the greatest difference in quiz scores was between the freshman and junior participants although post hoc tests, using Sidak analysis, did not show a significant difference ($p = .06$).

**Discussion**

While this research failed to show that participants with lower scores on an operation span task benefit more from using the SOAR method than people with higher scores on an operation span task, it was able to show that the SOAR method is a more effective study strategy than the 3R method on the present task. While both the 3R method and the SOAR method have been shown in previous research to be better study strategies than the note-taking and recitation typically used by college students, participants who used the SOAR method did receive higher scores on tests than the participants who used 3R method. Since the SOAR method utilizes selection of main information and organization of that information it was thought that this method would help people with lower scores on working memory tasks be able to better attend to the important information and it may have done so, however participants with all ranges of working memory scores scored higher on quizzes of factual information than their 3R counterparts. This increase in quiz scores may have been due to the type of information that was presented for the participants to memorize. This research focused mostly on factual information.
and very few questions required students to compare the information to form their own conclusions. Most of the information required was memorization of numbers and names.

Actual college classes however require students to do much more than memorize lists of information. In an actual classroom setting students would be required to compare and contrast information and make their own conclusions concerning relationships as well as complete multiple quizzes, tests, essays, research papers, and class projects to demonstrate their understanding of the information. This research utilized the test and quiz aspect of learning, but did not include an aspect that would be similar to writing an essay or showing understanding through a project. This research focused primarily on the memorization of facts and information whereas an actual classroom setting would require students to go a step further in their learning experience and also create their own deductions.

The difference in quiz scores based on year in college was a surprise in the findings. Since this difference only occurred between juniors and freshmen and did not include sophomores or seniors it may be that this difference was a fluke as there were also no significant differences between them in any other area. It is also likely that the participants who were juniors are more likely to be psychology majors who may have already encountered some of the information on one of the quizzes (most likely the quiz concerning scientists who influenced the field of psychology). Whereas the freshmen may not be as familiar with the information and the juniors and seniors in the participant pool are more likely to be from other majors who are less likely to be familiar with the history of psychology. It also may be that the older participants in this study experienced a gradual maturation of study skills since their freshman year of college. Since college is a lot more difficult that the high school experience that freshman had already
grown accustom to the differences in test scores may be due to an adjustment in study strategies that occurs during the early years of college.

A more life-like version of this study may include a 3-4 week experiment that imitates a classroom setting. Within this setting students would learn a larger range of related material primarily utilizing their assigned study strategy. The experiment would expand to include short answer and extended response questions as well as a project or an essay to better mimic an actual classroom experience and to give students different ways to demonstrate learning.

It also may be that both methods focused too much on extra attention toward specific information. Since there was no true control group further research would need to be held to determine how each method would hold up against a control method and no study method. Since both the 3R method and the SOAR method require students to select out the relevant information it could be that regardless of type of study method, the extra step helped students retain the information rather than a higher or quicker processing helping them to do so. Then again, since this research involved a college population, it may be that those with lower working memory may have already developed the skills necessary to make up for their lower processing or learned to ignore distractions in the essays. These participants may have already learned ways to better learn information that they then used as well as their assigned study strategy during the research. It would be interesting to bring the research into a high school or elementary school setting where would be a more diverse population with varying levels of intelligence and working memory.

Another area that was not examined is presence of another person (the researcher) causing anxiety while listening and watching the participants study and take a quiz. It might be possible that the researcher caused anxiety and thus distracted the participants from the task at
hand. While the automated operation span task was always completed by participants in a secluded room with no distractions, the studying and quiz portion of this research was conducted in an open room that had the potential for distractions. Some participants completed the task with another participant or two sitting in the same room while others completed the tasks with only the researcher in the same room. Although no information was recorded regarding the presence of others it would be advisable to keep distractions at a minimal level the participants need to be in a secluded room while completing the studying and quiz portion of this research.

With the high correlation between scholastic achievement and working memory, as found by Bühner, Kröner, and Ziegler (2008) a difference in test performance based on working memory scores was expected. This relationship did not occur in the present research however; therefore an examination on whether the set of quizzes presented to participants clearly reflects the type of information and tasks that is required for students to pass college courses would be necessary. It may be more of a reflection of the use of surface-level cognition rather than the deep-level cognition that is typically required of college students. As has been shown in previous research the study methods change based on tasks (Ross, Green, Salisbury-Glennon, & Tollefson, 2006; Hadwin, Winne, Stockley, Nesbit, & Woszczyna, 2001). Therefore, while the SOAR method might be better for college students taking multiple-choice or short answer tests another study method might be better for extended response or essay tests.

Regardless of the role of working memory, these findings merit a closer examination of the SOAR study strategy as a possible strategy that can be taught to kids at a young age to help them better learn and retain information. Further research does need to be conducted to see how students of different ages are able to use this method effectively as well as how this method can be adapted to help students with deep-level cognition tasks. Also since working memory has
been correlated to academic achievement further research could examine the role of working memory within this study method, especially the role of the central executive and the episodic buffer. It may be that this study method helps more with the integration of information from working memory into long-term memory rather than the working memory processes alone.
References


Figure 1. Mean total quiz score based on study method.
Table 1

*Demographic Characteristics of Participants*

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>SOAR</th>
<th></th>
<th></th>
<th>3R</th>
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<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td><strong>Mean AOspan</strong></td>
<td>n</td>
<td>%</td>
<td><strong>Mean AOspan</strong></td>
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<tr>
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<td>43.71</td>
<td>21</td>
<td>47.7</td>
<td>44.89</td>
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<td>43.46</td>
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<td>52.3</td>
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<td>43.56</td>
<td>44</td>
<td>100.0</td>
<td>44.98</td>
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<td></td>
<td></td>
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<tr>
<td>Freshman</td>
<td>29</td>
<td>64.4</td>
<td>42.34</td>
<td>27</td>
<td>61.4</td>
<td>43.65</td>
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<tr>
<td>Sophomore</td>
<td>17</td>
<td>15.6</td>
<td>49.43</td>
<td>11</td>
<td>25.0</td>
<td>43.40</td>
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<tr>
<td>Junior</td>
<td>6</td>
<td>13.3</td>
<td>43.83</td>
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<td>4.5</td>
<td>43.50</td>
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<tr>
<td>Senior</td>
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<td>9.1</td>
<td>71.50</td>
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<tr>
<td>Total</td>
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<td>100.0</td>
<td>43.56</td>
<td>44</td>
<td>100.0</td>
<td>44.97</td>
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</table>

Table 2

*Mean Total Quiz Score Based on Study Method*

<table>
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<th>Study Method</th>
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<th>SE</th>
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<tbody>
<tr>
<td>SOAR</td>
<td>45</td>
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<td>0.58</td>
</tr>
<tr>
<td>3R</td>
<td>41</td>
<td>20.78</td>
<td>0.62</td>
</tr>
</tbody>
</table>
Appendix A

Demographic Questionnaire

1. What is your gender?
   Male          Female

2. What is your age?
   _______

3. What is your class status?
   Freshman  Sophomore  Junior  Senior  Other
Appendix B

**Inner Planets Essay**

This essay will focus on the four terrestrial planets. The information you need to focus on studying, using your assigned study method, is the Greek name, diameter, distance from sun, density, composition, moons, and space missions. You are not expected to answer every item correctly, but please give your best effort and please answer every question.

**An Overview of the Solar System Formation**

The eight major planets can be divided neatly into two groups of four. Close to the sun are the four inner, terrestrial planets—so called because they are more or less Earthlike. Far from the sun, beyond the asteroid belt, orbit the four gas giants. The inner planets are compact and rocky, with a paltry three moons among them. Their outer siblings are huge and vaporous, possessing rings and more than 160 natural satellites.

**Mercury**

The Greeks named this planet Apollo and Hermes depending on the time of day it was seen. Mercury is around 3,000 miles in diameter. It has an off-center orbit, which at its closest is 28 million miles from the sun. It is virtually airless so its temperature range is the most extreme of all the planets. Although it is the smallest planet, it is surprisingly dense at 5.43 g/cm³. This density is likely due to an iron core with a thin silicon crust. It is one of the few planets that do not have any moons. NASA has had two missions to Mercury: Mariner 10 and MESSENGER.

**Venus**

Named for the Greek goddess of love, Venus is the brightest and hottest planet in the solar system, only surpassed in brightness by our own moon and the sun. This second planet orbits the sun on average 67 billion miles away. It is 7,500 miles in diameter and has a density of 5.24 g/cm³ with its size, density, and surface gravity similar to Earth’s. Like Mercury it does not have any orbiting moons. Although Venus does contain an atmosphere it is very dense, composed of carbon dioxide, nitrogen, and sulfur dioxide. While there is some water vapor here, it is very small amount. Venus has been studied in 44 space visits with the most from the USSR’s Venera missions.

**Earth**

Our Earth is the third planet from the sun with an average distance of 92 billion miles from the sun. At almost 8,000 miles in diameter and a composition density of 5.5 g/cm³. Earth has the perfect conditions to sustain life. Earth is composed mostly of iron, oxygen, and silicon. It has sustained less damage than the other planets, but the singular moon is covered in craters.

**Mars**

With its red exterior, Mars was named for the Greek god of war. Orbiting at 141 billion miles from the sun, Mars is also 4,000 miles in diameter. It is much less dense than the Earth at 3.94 g/cm³. Like Earth, it has its own atmosphere, clouds, and polar caps which made many believe that out of all the planets in our solar system Mars would be the next likely to sustain life. Mars has two moons that orbit it. It contains mostly iron, nickel, and sulfur. With a total of 39 attempted space missions to Mars, only 14 completing their missions, most of which are part of the Mariner and Mars mission programs.
## Appendix C

<table>
<thead>
<tr>
<th>Planet</th>
<th>Greek name</th>
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</table>
Appendix D

**Inner Planets Quiz**

Please answer these questions concerning the essay that you have just read and studied. Remember that you are not expected to answer every item correctly, but please answer every item and give your best effort. Remember that the four inner planets in the essay were Mercury, Venus, Earth, and Mars.

1. What planet has the smallest diameter?
   - A. Mercury
   - B. Venus
   - C. Earth
   - D. Mars

2. Which planet does not include iron in the main compositions?

3. Number the planets in descending order based on number of missions, with 1 being the least and 4 being the most.
   - ___ Mercury
   - ___ Earth
   - ___ Venus
   - ___ Mars

4. What planet was known as Apollo and Hermes by the Greek?

5. Which planet is closest in diameter to Earth (8,000)?

6. Which two inner planets were named after Greek gods?

7. Name the planets that do not have any moons.

8. Which planet is closest to the Earth?

9. What is the main difference between the inner and outer planets (besides location from the sun)?

10. Which planet is the brightest?
Appendix E

War Essay

The following essay concerns 4 wars in which the United States played a role. The information you need to focus on studying, using your assigned study method, is the year range for the war, who was involved in the war, the characteristic or noteworthy warfare used, and the results of the war. You are not expected to answer every item correctly, but please give your best effort and please answer every question.

World War I

WWI began in 1914 when Franz Ferdinand and Gavrilo Princip were assassinated on June 28, 1914. The US was with the Allies, who consisted of France, Russia, Italy, and Japan. They fought against the Central Powers, who consisted of Germany, Austria-Hungary, and Turkey. World War I was characterized by trench warfare (deep long rows of trenches dug so that each army could sleep, eat, and fight within them) and submarine warfare (most notably the Lusitania which was sunk by Germany). The war ended with the signing of the Treaty of Versailles in 1919. Germany was forced to acknowledge guilt for the war, pay the other countries for the damage they caused, reduce the size of its armed forces, and return territory claimed during the war.

World War II

WWII began in 1939 with the Nazi invasion of Poland. The US joined the Allies (Britain, France, and the USSR) after the Japanese attack at Pearl Harbor in 1941. The Japanese were allied with Germany and Italy to create the Axis Powers. Italy surrendered and joined the allies in 1943, after D-Day in 1944 Germany subsequently surrendered to the Axis powers in 1945, finally also in 1945 the Japanese surrendered to the Axis powers following the US dropping atomic bombs on Hiroshima and Nagasaki. The war ended with chaos between the death of 6 million Jews from the concentration camps in Nazi Germany and the destruction of major cities due to the bombings.

Korean War

The Korean war, also known as the Korean Crisis, broke out in 1950 with a host of invasions by North Korea (Democratic People's Republic of Korea) into South Korea (Republic of Korea). The Korean War is noted as being part of the aftermath of WWII and the beginning of the cold war. North Korea, a communist country, was supported by China and the Soviet Union, which South Korea, a non-communist country, was supported by the UN, US, and UK. This war was noted for the use of aerial warfare and the first using jets. A truce in 1953 in North Korea returned the separation between North and South Korea.

Vietnam War

The Vietnam War began in 1954 as another part of the cold war. North Vietnam was allied with Viet Cong alongside Khmer Rouge and Pathet Lao. South Vietnam was allied with the US alongside South Korea, Australia, Philippines, New Zealand, Thailand, Khmer Republic, and Kingdom of Laos. This war was noted by the heavy use of guerrilla warfare and the first war in which helicopters were used. After a cease-fire in 1973, the war officially ended in 1975 with a North Vietnamese victory. The US withdrew from Indochina, communist governments were created, and North and South Vietnam were unified into the Socialist Republic of Vietnam.
### Appendix F

<table>
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<th>War</th>
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<tr>
<td>Vietnam</td>
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</table>
Appendix G

**War Quiz**

Please answer these questions concerning the essay that you have just read and studied. Remember that you are not expected to answer every item correctly, but please answer every item and give your best effort. Remember that the four wars included: WWI, WWII, Korean War, and Vietnam War.

1. Which war was the shortest?
   - A. WWII
   - B. Vietnam War
   - C. Korean War
   - D. WWI

2. In which war was the US and Japan allied?

3. Number the wars based on chronological order, with 1 being the first and 4 being the last.
   - ___ WWII
   - ___ Vietnam War
   - ___ Korean War
   - ___ WWI

4. Match the war with the type of warfare used or most notable for.
   - ___ WWI
   - ___ Vietnam
   - ___ WWII
   - ___ Korean
   - a. Atomic Bombs
   - b. Trench Warfare
   - c. Helicopters
   - d. Jets

5. Which war was the first to also use submarines?

6. Which war is the only listed that involved mostly non-World powers?

7. During the Korean War which 2 countries or organizations were allied with North Korea?

8. Which war was the shortest?

9. Which war ended in the unification of two countries?

10. Which war lasted the longest?
Appendix H

Scientist Essay

The following essay concerns 4 scientists who greatly influenced the field of psychology. The information you need to focus on studying, using your assigned study method, is the birth and death dates and location, university or universities they studied at, places they taught at, and what they are known for. You are not expected to answer every item correctly, but please give your best effort and please answer every question.

Wilhelm Wundt
Born in Germany in 1832 Wilhelm Wundt was best known as the founder of experimental psychology and the father of modern psychology. He developed one of the first two experimental labs and began the first course in experimental psychology. In his youth he studied at Tubingen, Heidelberg, and Berlin and he later taught at Heidelberg, Zurich, and Leipzig. He was also known for his work in experimental introspection, which is the study of the mind using observation and measurement, such as reaction time and attention. Wundt died in 1920 in Germany at the age of 88.

William James
William James was born in New York in 1842. He was a philosopher who both studied and taught at Harvard. He is known as the founder of functional psychology. He studied philosophy based on pragmatism, which is the belief that value is dependent on its use, and free will, which is the belief that one has control over his or her life rather than it being predetermined based on environmental conditions. Around the same time that Wundt developed his experimental lab James was also opening his own. James then died at 68 years old in New Hampshire in 1910.

Jean Piaget
Born in 1896 in Switzerland Jean Piaget is noted for his work in developmental psychology. He studied at the University of Neuchatel and the University of Zurich. He later taught at Grange-Aux-Belles Street School for Boys and the Rousseau Institute. One of his most well-known accomplishments was the theory of the four stages of development: the sensorimotor stage, the preoperational stage, the concrete operational stage, and the formal operational stage. He also focused on doing epistemological research directly with children to better understand how they learned and what they were capable of as the aged and developed. He later died in Switzerland in 1980 at the age of 84.

Rene Descartes
Born in France in 1596 Rene Descartes studied at the University of Poitiers, University of Franeker, and Leiden University. He also later taught at Utrecht University. Descartes was a philosopher and mathematician. He is known as the father of modern philosophy for his use of methodological skepticism. He believed that you cannot trust your senses so you must use your mind to study the world around you. He also believed in mind-body dualism, he believed that the body acted as a machine and the mind is a nonmaterial entity that controls the body through the pineal gland. He later died at the age of 54 in Sweden in 1650.
## Appendix I

<table>
<thead>
<tr>
<th>Birth Death</th>
<th>University</th>
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<th>Specialization</th>
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<tr>
<td>Rene Descartes</td>
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</tbody>
</table>
Appendix J

Scientists Quiz

Please answer these questions concerning the essay that you have just read and studied. Remember that you are not expected to answer every item correctly, but please answer every item and give your best effort. Remember that the four scientists include: Wilhelm Wundt, William James, Jean Piaget, and Descartes.

1. Who believed in mind-body dualism?

2. Who was the only scientist listed that studied and taught in the US?

3. Number the scientists based on birth order, with 1 being the first and 4 being the last.

   ___ Wundt
   ___ James
   ___ Piaget
   ___ Descartes

4. Match the scientists with their major accomplishments.

   ___ Wundt   a. stages of development
   ___ James   b. methodological skepticism
   ___ Piaget   c. experimental introspection
   ___ Descartes d. founder of functional psychology

5. Name the two scientists who taught at the same universities in which they studied.

6. Which scientist was born and died in different countries?

7. Which two scientists studied at 3 or more universities?

8. Who is the founder of experimental psychology??

9. Which scientist lived the longest?

10. Who developed the first experimental labs (hint: 2 scientists developed them at the same time)?