Positive Effects of Breakfast on Memory Retention of Students at the College Level

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Abstract

Memory retention is important for students, and little study has been done to confirm that cognitive processes are sustained by nutrition at the college level. The effect of breakfast on short-term memory retention was tested on 20 students at Saint Martin’s University. Subjects were tested on two different days, once after consumption of breakfast foods, and once without consumption of breakfast. Using one word list, three face recognition tests, and one object test, the students were tested to determine whether breakfast aided in their cognitive functioning. After utilizing a paired t-test to statistically analyze the data, it was suggested that there was a significant difference between the breakfast consumers and those who did not consume breakfast ($t=3.39; p=0.003$). Overall precision in short-term memory showed that 16 students improved in memory testing after the consumption of breakfast. Many college students do not have the time for a meal before classes, however this study suggests that breakfast consumption may have positive effects on memory retention within the college classroom.

Introduction

It is cross-culturally known that daily nutrition is essential to the existence of humans (Rampersaud et al., 2005; Ritz and Berrut, 2005). Deprivation of a meal leads to dysfunctional states of the mind and physical self, such as loss of short-term memory and delayed reaction times (Fischer et al., 2002). Humans, students specifically, are especially susceptible to the negative effects of food deprivation due to the high demands of societal and academic achievement (Grantham-McGregor, 2005). Extensive research has been done on how children are affected by the lack of nutrition before testing (Grantham-McGregor, 2005; Rampersaud et al., 2005; Squires, 2005; Taras, 2005), but there has been little development in the area of students at the college level.

How does nourishment assist in the capacity to retain information and assist in the learning process? According to Taras (2005), nutrition and student achievements have been connected, and without proper fuel for the body, the mind will cease to function to the best of its ability. Proper fuel, or “normal amounts of nutrition”, is described as eating a balanced meal that includes various food groups (Rampersaud et al., 2005; Taras, 2005). Once the body obtains the amount of nutrients that it needs, mental clarity, recognition, and comprehension will follow shortly.

Nutrition is a vague term and can include many elements of daily diets. The nutrients described in this research refer to protein, fiber, glucose, and carbohydrates within various foods. In individually large amounts, each of these types of nutrition can be harmful to the body in terms of weight gain and high cholesterol levels (Fischer et al., 2002; Rampersaud et al., 2005). However, a balanced meal including all four of these energy-builders has the ability to
increase cognitive functioning before testing (Fischer et al., 2002; Ritz and Berrut, 2005).

Funder (2004) discussed the theory of ascending reticular activating system, or ARAS, in the human brain. Eysenck’s theory is extended to the balance of the excitatory and inhibitory mechanisms, and when a balance is achieved then a certain level of cognitive arousal takes place (Funder, 2004). The ARAS is suggested to regulate the amount of information that reaches the brain (Funder, 2004). Nutrition is one factor that may easily affect the delicate balance, cutting off the appropriate arousal to bring about cognitive processes and memory retention in an individual.

Cognitive functioning occurs when serotonin and amino acids are at standard levels for each person (Fischer et al., 2002). Hormone levels vary for each individual, but the hormones are significant in the ability for humans to acquire new information. Another factor that alters intellectual and perceptual performance, is the energy shipped to nerve tissue in the brain (Fischer et al., 2002). Student performance is altered through lack of sufficient energy to the brain for cognitive thinking as well as the ability to focus clearly (Benton and Parker, 1998; Fischer et al., 2002).

A balance of protein, fiber, carbohydrates, and glucose will enhance the learning process, while individually large amounts of these nutritional substances are likely to subdue scholarly cognition (Fischer et al., 2002). These nutritional elements include protein and fiber diets that have been known to assist in weight loss (Fischer et al., 2002). These elements also stimulate energy connections to guide a student’s ability to comprehend (McDonald, 2001; Fischer et al., 2002). Carbohydrates are helpful to the body, in small proportions, because they carry glucose that the body feeds on to ensure that the brain operates and provides clarity for cognitive performance (McDonald, 2001). Glucose, of which carbohydrates are composed, aids in cell interactions and neurological functioning (Wang et al., 2004).

It is important to realize the distinct difference between learning and memory retention. The ability to learn new information depends on many environmental factors affecting a person (Patterson, 2001). For example, a student has external factors that affect their ability, or inability, to learn the necessary material. The student may have personal issues that affect his or her concentration, whereas the lack of nutrition would affect their biological state. Patterson (2001) illustrated how the nervous system picks up all of the stimuli that our body receives and transfers it to the subsystems of the central and/or peripheral nervous systems. Without the student’s ability to retain course material, how would teachers be able to successfully measure the amount of information that has been learned (Patterson, 2001)? It would be nearly impossible to measure retention and academic success without the capacity to retain information (Patterson, 2001).

Nutrients are beneficial to both body and mind, and they are the energy that flows through our physical selves (Fischer et al., 2002). Blood flow and neural stimulation is circulated through the body to increase both short and long-term memory storage (Patterson, 2001; Ritz and Berrut, 2005). How do physical symptoms influence mental and cognitive thinking? All aspects of the body are intertwined, so when one area does not get what it needs, it does not function properly.

Korol and Gold (1998) reviewed the importance of nutrition in their research of college students and adolescents by studying the influence of glucose on school performance. Students were given memory tests involving drawings and word lists (Korol and Gold, 1998; Pollit et al., 1998). The results showed that when 50 grams of glucose were given to students who don’t eat breakfast daily, their memory retention and school performance substantially
improved. No change was found in students who ate breakfast daily.

Taras (2005) examined studies in which malnutrition affected the ability of children, especially those 5-18 years old, to concentrate and recall information for examinations. The children were chosen for the study based on school attendance, cognitive functioning, and their ability to pay attention in the classroom environment. Improvements in memory retention were made in every area, including math, verbal English, written activities, imagination, and physical stamina (Ritz and Berrut, 2005; Taras, 2005). Overall, Taras (2005) found that eating breakfast before classes and tests improved the ability to operate clearly and retain taught lessons, and therefore, recommended adolescent children should eat a meal before testing to improve mental performance.

The measures used to assess memory retention in children and adolescents are vital in achieving valid results (Grantham-McGregor, 2005). Pollitt et al. (1998) found behavioral tests, including visual and auditory stimuli, which tested the idea that fasting affects student cognition, memory retention, and behavior. The Hagen Central Incidental Test, which is an assessment of memory retention, traditionally provides participants with visuals of animals alongside other objects (Pollitt et al., 1998). These tests could not be found so visual aid concepts were adopted from Chudler (2006) memory tests. Benton and Parker’s (1998) word list philosophy provided subjects with one word per two seconds. The university students were asked to write down as many words as they could recall after a certain period of time (Benton and Parker, 1998). Word lists in this experiment mimicked Chudler’s (2006) memory tests found through the University of Washington.

Nutrition is a key factor in determining a person’s ability to retain visual and auditory stimuli (Fischer et al., 2002). Once the brain obtains a sufficient amount of energy, determined by each individual’s needs, it better understands the information sent to and from various regions of the body. Neurotransmitters in the synaptic cleft fire normally, or on a regular basis (Fischer et al., 2002; Rampersaud et al., 2005). When sufficient energy is passed through the body and the brain, concentration within the individual increases. Being able to concentrate is the key element in being able to retain information for students.

Rampersaud and colleagues (2005) found that optimal nourishment assists in a child’s growth and development. These researchers gathered studies on children and adolescents to analyze the data and provide statistics for easy understanding. They concluded that consumption of a balanced breakfast has declined over the last century, and students are suffering because of a lack of nutrition (Grantham-McGregor, 2005; Rampersaud et al., 2005). Partly due to this lack of nutrition, test scores and school attendance have decreased, and once breakfast was introduced into a healthy diet, scores were greatly improved, as did the ability to focus in the classroom (Grantham-McGregor, 2005; Rampersaud et al., 2005; Squires, 2005).

Although poor school performance can be attributed to other issues such as socioeconomic burdens and relationship influences, nutrition is a key aspect (Grantham-McGregor, 2005). If children are hungry in the classroom, they will not be able to concentrate on anything else but meeting their basic needs. Grantham-McGregor (2005) regards breakfast as significant to a growing mind and body, but also believes that the type of breakfast consumed is important. For example, giving children a ready-made breakfast, like most sugar cereals on the market today, will increase the glucose level (Whitney & Rolfes, 2002; Grantham-McGregor, 2005; Squires, 2005). This increase in glucose alone will increase mind activity, but not in
Glucose has shown to increase hyperactivity in school-aged children and adolescents (Benton and Parker, 1998; Grantham-McGregor, 2005). Benton and Parker (1998) found that controlled amounts of protein, carbohydrates, and fat in a given drink increased memory retention among university subjects. Out of the students who ate breakfast regularly throughout the week, the glucose drink did not affect 95 percent of the subjects, though memory retention of students who skipped breakfast increased. Individual differences in the ability to tolerate glucose were noticed in the study. Age could also be a factor in the effects of glucose. Glucose has shown to directly influence memory retention in university students who do not eat breakfast regularly, but it has altered mental states in elementary-aged children and adolescents (Benton and Parker, 1998). Testing university students over the age of 18 years provided further information on the concept of an older age group and their memory retention.

Grantham-McGregor (2005) continued her research by examining 4 studies in the United States, Jamaica, and Peru where evidence was provided for the positive effects of breakfast for children, ages 6-8 years. In the studies, children were authorized to stay in a laboratory facility so that their actions could be analyzed. The following day, random samples of students were given breakfast and the remaining were not given any food. The children who had eaten before testing were found to be increased in both cognition and physical well being (Grantham-McGregor, 2005). The children deprived of food were found to be detrimentally influenced by the lack of food, and cognition decreased directly with the continuance of fasting (Grantham-McGregor, 2005).

Environmental influences that can alter a student’s concentration include domestic issues, economic issues, physical impairments, learning disabilities, and personal issues (Fischer et al., 2002; Grantham-McGregor, 2005; Taras, 2005). Although many external factors manipulate student’s cognition and memory retention, nutrition is the only issue that was examined in this study.

Students, especially ones at the collegiate level, in modern United States society, often do not have time for the traditional three meals a day. A majority of college students do not receive the nutritional balance that their bodies require in maintaining higher memory retention (Rampersaud et al., 2005; Taras, 2005). The central and peripheral nervous systems are not sent a sufficient amount of energy essential for daily functions, which, for students, includes retaining lectures and taking related course exams (Patterson, 2001).

There has been research to indicate nutrition is important to the growth of children and adolescents (Grantham-McGregor, 2005; Rampersaud et al., 2005; Ritz and Berrut, 2005; Taras, 2005). My study tested the importance of nutrition for students at the college level as well. The importance of linking this idea to collegiate students is to understand how a healthy diet is vital to students of all ages, since nutrition affects memory retention and academic achievement.

Does the importance of eating a balanced breakfast before testing change as we grow older? We are constantly told that calcium, fiber, and protein are a significant part of a well-balanced diet regardless of age (Rampersaud et al., 2005; Squires, 2005). Numerous studies have been done on child memory retention, however little study has been done on college students and effects of nutrition on their memory retention (Pollitt et al., 1998; Rampersaud et al., 2005; Taras, 2005). My hypothesis was that college students retain more information when they consume breakfast before testing. It is
anticipated that college-level breakfast eaters retain more information than their counterparts who do not consume the proper nutrients before testing.

**Methods**

**Obtaining Participants**

The research focused on traditional and non-traditional college students, over 18 years of age, at Saint Martin’s University (SMU). The students were randomly selected from the SMU community. There were 20 positions available in the memory testing series. Alternate students were asked to assist in the experiment in place of their peers when certain students were not available for both scheduled testing sessions. Students who were not able to participate in both sessions were replaced with alternate subjects, and they were dropped from the study. No test scores were gathered from these dismissed subjects.

The effect of breakfast on cognition was considered in the analysis of testing scores. Career path and gender were not factors in the comparison of the results. The effect of grade point averages and interest in higher level education also were not factors since the ability to retain information is not correlated with grades or knowledge of course material (Grantham-McGregor, 2005). Unfortunately, due to limited time and funds, finding willing participants was challenging. Students who were not able to attend the testing sessions were asked to assist with the study by filling out a survey about their breakfast habits. An example of the survey can be found in Appendix A. These survey responses were taken into consideration when preparing statistical information about the SMU community.

Emails were sent to gather participants, and students from various SMU classes were accepted into the study. Nutrition wasn’t the only factor present in the study, since there are many other elements that possibly impact a student’s inability to concentrate on given information. For the purpose of the study, nutrition was the only factor evaluated.

**Group Division**

The intention of the experiment was to identify the importance of eating before exams during a college student’s academic career. The students were separated into 2 groups: A and B. Each of the 2 groups contained 10 students, making a total of 20 participants. Group A was given breakfast on day 1 of the testing series, while Group B did not receive breakfast on that day. Group A did not receive breakfast on day 2, while Group B was given breakfast on day 2.

**Memory Testing**

The testing series consisted of 5 memory tests, and there were 3 types of tests given. The participants were given different memory tests on each testing day to discourage recognition of information from the first set of tests to the second set. Students who ate breakfast before testing the first time, Group A, did not receive breakfast before the second test. Students in Group B did not receive breakfast the first day, however they were given breakfast before testing on the second day. This allowed for comparison of the test scores from the first test to the second test for each individual. The same memory testing procedure was used for both groups on both days.

Students were given 15 minutes to eat breakfast before the memory testing began. Once the 15-minute period had elapsed, students took part in five memory tests to examine memory retention with, and without, the intake of nutrients. Group A and Group B began testing at the same time.

The 5 tests were a combination of visual image concepts practiced by Pollitt et al. (1998) and a word list concept utilized by Benton and Parker (1998), with a few variations. Actual testing materials were obtained from the education program at the
University of Washington (UW) (Chudler, 2006). The memory exams were visually shown from a PowerPoint slideshow on a projector or were shown on a computer if the individual could not attend the group session. Variations of the test were given to each participant who could attend the group sessions. The face tests were randomized each time a subject took them. This prevented participants from sharing information before others took the test.

These basic memory tests were utilized because of the various participants involved. If a specific area of study had been used in this research, students who specialize in that area would be likely to do better on the test. For example, a student in the science department should know more information about biology-related terms than a student whose focus lies in the arts.

Combining these three tests provided a variety of materials to examine memory retention. The students began testing immediately by viewing a face that had irregular facial features. The nose, mouth, hair, cheeks, and chin were different shapes, which made the features difficult to remember. This face was shown to the participants for 10 seconds. An example of the face test can be found in Appendix B. Then, the image was minimized and the participants were asked to fill in the blanks on an answer sheet (Chudler, 2006). A sample of the answer sheet can be found in Appendix B.

The second test consisted of a diagram of 25 random objects; the students were allowed 30 seconds to view the objects. The screen was again minimized after the appropriate time had elapsed, and students were asked to write down as many of the objects as they could remember (Chudler, 2006). An example of the object test can be found in Appendix B. The third test included another unusual face, and the participants were asked to recognize facial features for the face they were shown.

A word list was shown to the participants for the fourth test, and three word lists were shown. Each word was shown for one second, and then nine words related to, or that were actually shown in the lists, were shown to the participants. Each person was asked to distinguish which of the nine words were shown within the initial word lists. An example of the word list can be found in Appendix B. The final test contained a third face memory test, different from the first two.

Since the facial feature memory test was randomized every time it was taken, there was no risk of memorization from one test to the next. A second object test, containing 25 different objects, was shown on day 2. Word lists similar to the first day test were used for day 2.

Consent Forms
All volunteers for the memory testing series were asked to sign a consent form before beginning the exercises. An example of the consent form can be found in Appendix C. The consent form stated that the information provided to the researcher was true to the best of the participant’s knowledge. It also informed the participant that the researcher was a college-level senior who was collecting data to test the thesis regarding the relationship between nutrition and memory retention. The form also explained the surveyor was not responsible for possible allergic reactions to breakfast provisions or psychological strain placed on the individual during the experiment. Consent forms provided confidentiality to the subjects and their participation in the study. The answer sheets for testing were also coded to ensure student confidentiality. Student survey responses were not matched with individual testing results for those who participated in the memory testing.

Breakfast Consumption
Breakfast was provided before memory exams to each member of Group A
for day 1, while Group B was not given breakfast. I relied on the honesty of the students who were being tested in both groups to not eat anything before they were advised to. I informed each group that they should not eat anything after midnight the night before the memory testing series.

Breakfast for each individual consisted of a balance of various nutritional food groups. Glucose, fiber, carbohydrates, and protein were provided in a simple, yet balanced meal to supply nutrients for cognitive functioning. The nutritional support was made up of yogurt, oatmeal bars, fruit, or a bagel along with their choice of milk, orange juice, or apple juice. Each student was limited to two breakfast items and one drink choice. Special requests from a participant with regard to health issues were arranged ahead of time. A few students provided their own breakfast, which were similar to those I provided, due to allergies and health issues. Those with no allergies were provided breakfast to control the type of breakfast consumed before testing memory retention.

**Data Analysis**

Nutrition is valuable to memory retention at the college level, just as it has been shown to directly affect children and adolescents in a positive way (Rampersaud et al., 2005). The data collected in this experiment tested whether a balanced breakfast provides students with increases of memory retention for recollection of class material and testing purposes. It is understood that there are many varying factors, such as socioeconomic status and personal issues for each individual, which could bias the results. This was taken into consideration in the testing environment, as well as during the study.

A paired t-test was used in the statistical analysis of all participants’ results (Minitab Inc., 2005). If the p-value was less than 0.05, then I rejected the null hypothesis that memory retention was independent of breakfast, and accepted the alternative hypothesis that memory retention was associated with eating breakfast before testing. After scoring each individual test, I compared the score for each person from day one to their score from day two. This comparison allowed for observation on whether breakfast, or lack of, had an impact on scoring for each individual. It is difficult to compare participants due to variation in testing styles and personal ability to retain information.

Statistical testing in the form of a 2x2 contingency table for overall comparison was performed (Zar, 1984). I used Group A and Group B along the y-axis and Day 1 and Day 2 along the x-axis; an example is shown in Table 1. The null hypothesis was that memory retention is independent of whether breakfast was eaten. The alternative hypothesis is that memory retention is dependent on the intake of breakfast.

As a final form of data analysis, adding all of the breakfast consumer’s correct answers and dividing by the total number of possible correct answers created a group mean (Minitab Inc., 2005). Repeating this procedure with results from the non-breakfast consumers allowed for a group mean as well. A standard deviation of 1 was also considered in the analysis. The standard deviation values were a useful tool in analyzing the experiment’s results; however they were not used as the primary data analysis.

**Table 1: Representation of mean samples of 20 college students for each group and the day in which they tested.**

<table>
<thead>
<tr>
<th></th>
<th>Test Day 1</th>
<th>Test Day 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>Avg. score</td>
<td>Avg. score</td>
</tr>
<tr>
<td>Group B</td>
<td>Avg. score</td>
<td>Avg. score</td>
</tr>
</tbody>
</table>
Results

Each participant received a score for the day on which they ate breakfast and a separate score for the day on which they were not given breakfast before memory testing. This makes 2 replicates of 20 students each, to compare breakfast eaters with non-breakfast eaters. The raw data are included in Appendix D. According to survey responses, the same students who had little difference between scores were the same students who did not eat breakfast on a regular basis, or at all, during the school week.

Individual scores are shown in Figure 1, comparing the day in which they ate breakfast to the day they did not eat breakfast before testing. Figure 1 shows that students achieved higher scores when breakfast was eaten before testing compared to when it was not. Sixteen out of the 20 college students obtained higher scores after eating breakfast.

A paired t-test was done on the student scores using the decimal values, and raw calculations can be found in Appendix D. The decimal value was entered into Minitab Release 14, where a paired t-test could be performed on the data (Minitab Inc., 2005). A paired t-test was used to determine which of the two hypotheses were supported by the sample data (Minitab Inc., 2005). It tested the effectiveness of breakfast before memory exams, and results showed a variation in response to breakfast provisions.

The paired t-test showed a statistically significant difference between the two groups (t=3.39; p=0.003). My null hypothesis that memory retention is independent of breakfast is clearly rejected. The results suggest that college students retain information better when breakfast is eaten before testing, than if no food is eaten.

Discussion

There was a significant difference t=3.39; p=0.003) between breakfast consumers and students who did not consume breakfast, which suggests that college students benefit from eating breakfast before retaining information. The p-value expresses the probability that the difference found was due to chance (Minitab Inc., 2005). In this study, the null hypothesis was rejected, and the alternative hypothesis was accepted, or at least not rejected. Breakfast eaters before memory retention testing performed better, overall, on the tests than the participants who did not consume breakfast.
Figure 1. The relationship between test scores after consumption of breakfast and test scores without consumption of breakfast before memory testing for 20 individual college students at Saint Martin’s University. Each black bar, and the corresponding white bar, represents a different individual’s scores.

Table 2. The effect of eating breakfast versus non-consumption of breakfast on 20 college students. Statistical analysis through a paired t-test gave mean sample percentages, t-value, and p-value for scores of each group.

<table>
<thead>
<tr>
<th>Number of Subjects</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ate Breakfast</td>
<td>20</td>
<td>0.72578</td>
<td>0.129986</td>
<td>3.39</td>
</tr>
<tr>
<td>No Breakfast</td>
<td>20</td>
<td>0.65468</td>
<td>0.121338</td>
<td></td>
</tr>
</tbody>
</table>

Figure 2: Relationship between mean test scores for participant breakfast consumption before testing and mean test scores for no breakfast consumption before testing for 20 Saint Martin’s University students. Each bar shows groups of 20 each for testing.
Table 2 shows the mean score provided by the paired t-test, where the mean test score was 72.6% after breakfast was eaten. The mean test scores for the day when students did not eat breakfast before memory testing was 65.5%. Mean score totals for each group, breakfast consumers and non-consumers, are shown in Figure 2.

The difference between breakfast eaters and breakfast skippers was expected, however a more consistent difference between the two group’s test scores was anticipated. Various researchers have suggested that students retain more course material after eating breakfast before class (Grantham-McGregor, 2005; Rampersaud et al., 2005; Taras, 2005). This appeared to be the case for 16 of the 20 students (or 80%) in this study. These student’s scores increased after eating breakfast, however the differences in individual test scores across the two testing days were not meaningful by themselves. For instance, one student scored an 80% on the day on which they ate breakfast before testing, whereas they scored 78% on the day they did not consume breakfast.

The modest difference between people’s scores indicated that eating breakfast before memory testing did not influence the participants who do not eat breakfast on a regular basis. It is suggested that this indifference to eating breakfast may have been due to the adaptation that bodies may have to their environment. If a student develops a tendency to not eat breakfast before school, then the body may be inclined to accommodate to this habit. These are not conclusions derived by the results, but explanations for what may have occurred for participants who did not consume breakfast on a regular basis.

Unanticipated results were seen when students who ate breakfast on a regular basis, according to the questionnaire replies, obtained a mean score of 65.5% when they didn’t receive food before memory testing (t=3.39; p=0.003). The student’s scores decreased when they were used to eating breakfast, and were asked to delay consumption until after testing. For example, when one student did not consume breakfast before testing, but usually ate breakfast on a daily basis, earned a 37.5% on the memory test. When the same person ate breakfast, just like they did everyday, their score increased to a 58.0%. It is interpreted that bodies adapt to their environments. If one is used to eating breakfast on a daily basis, then for their body to be fully functional they may need to be nutritionally sustained before memory testing.

More factors were involved in this experiment than were taken into account before testing participants. Various conditions were controlled including the amount of food each participant was given, the type of food was monitored, the memory tests were similar in nature for each participant, and the environment in which they were tested was controlled. Environmental aspects of the experiment that were independent of the researcher’s control was the participant’s decision to eat a snack before the study, stresses in each participant’s personal and professional lives, and each student’s ability to retain information on any given basis.

The external factors and/or stresses that a participant may have been dealing with could have had an effect on how well a participant did on a memory test. Doing poorly one day during the memory testing could have been due to these external factors, such as midterms or personal issues. Since the tests did not count for a grade, the student could have blown each test off, and didn’t try hard to reach into their short-term memory for the answers.

The participants were given 15 minutes to eat before testing their memory
retention. After testing half of the participants with this method, it was considered that limited amount of time allowed for the food digestion may have influenced raw data values. Time for eating was limited due to scheduling with participants, leaving 45 minutes to test each person. Taking the experiment further, by increasing the amount of time given to each student to consume breakfast to one hour may yield different results.

It was important to take into consideration the types of food that were being eaten by the participants, because different food types could affect memory retention in two ways. Healthier foods, such as oatmeal or fruit, could give students positive effects, while junk food, such as pancakes with syrup or meals high in only glucose and fat, could have more negative effects on memory retention (Benton and Parker, 1998; Grantham-McGregor, 2005).

Testing the types of foods consumed on memory retention would be an interesting factor, if the experiment were taken further. Testing students before eating a fast food breakfast may yield results differing from a breakfast consisting of oatmeal, toast, and juice. Another factor to be tested, if the experiment were done again, could be memory retention and eating during various times of the day. Students could be tested with or without eating breakfast, and be tested later in the day with or without eating lunch. Eating at different times of the day is a possible variable to consider when student retention is concerned.

Short-term memory testing sessions involved in this study would be useful as a preliminary report for a larger study in the future. Data collected from the 20 participants could serve as an introductory experiment to assess participant interest and estimate how well college students performed overall. A more complete sample would consist of at least 100 college students from 4 colleges in the area, and it could include more non-traditional students (older in age) as well as community colleges, state colleges, and universities to assess the possible differences among types of schools. Once the sample is larger, sufficient information could be gathered to make convincing claims that breakfast before testing has a large impact on student memory retention.

The experiment was discussed, excluding individual results, with participants of the study regarding their reaction to the test and the experiment question itself. A few participants offered that they felt pressure to do better on the testing day when they ate breakfast beforehand. They felt pressure from themselves as well as from what the results would show. They attempted to do better on that test, because they believed that students usually did better if they ate before retaining course material. If the study was performed again, this factor could be taken into account, and the study could be turned into a blind study (Funder, 2004). A blind study would have provided the student with enough information about the test without a chance of biasing the results (Funder, 2004). The students would be told that a study is being conducted on the types of memory tests given to college-aged students. This would be deceiving the participants, however psychological testing is done this way many times to avoid gathering influenced results (Funder, 2004). According to Funder (2004), the University and the institutional review board concerning human participants must decide upon this idea of “deceit” and informed consent.

Researchers have focused on child and adolescent nutritional behaviors, and they have neglected older age groups for memory retention research (Pollitt et al., 1998; Grantham-McGregor, 2005; Rampersaud et al., 2005). Utilizing college
students for memory testing research has allowed me to gather data that supports the theory that breakfast has an influence on a person’s ability to retain information, regardless of age. A paired t-test suggested that my hypothesis that memory retention is associated with breakfast be accepted (t=3.39; p=0.003). Recommendations for further research involve larger sample sizes, as well as controlling types of breakfast foods given to participants before testing. However, on average, breakfast-eaters were found to score higher on memory tests than people who do not eat breakfast.

Acknowledgements

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Literature Cited


## APPENDIX A

**HOW DOES BREAKFAST INFLUENCE YOUR MEMORY RETENTION FOR COLLEGE COURSES? Subject Questionnaire**

Name (optional): ____________________________

Age: ____________   Gender: ________________

Would you like to participate in two 45-min memory tests sessions for this study?
Circle one:

- Yes   
- No

Year in school: freshman   sophomore   junior   senior

On average, how many days per school week (Monday through Friday) do you eat breakfast?

If you do eat breakfast, what does it consist of?

If you don’t eat breakfast regularly, what are some reasons why you don’t? (circle all that apply)
- no time
- don’t like eating in the morning
- no food in house
- other ____________________________________

If you had more time, would you eat breakfast on a daily basis?

Do you usually eat breakfast before exams? If so, list the foods/drink you eat…

On any given day, rate your stress level below:

<table>
<thead>
<tr>
<th>Not Stressed</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>Extremely Stressed</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
</table>

Please FILL OUT this section ONLY if you are participating in STUDY…

If participating in the study sessions, mark which two food choices and one drink of choice (if you have specific allergies, please talk to researcher to make accommodations):

- bagels
- yogurt
- orange juice
- milk
- oatmeal
- fruit: (specify) _________
- apple juice

Other: ______________________________________

Appendices B-C are available upon request.
APPENDIX D

Table 3: Raw Data displaying test scores and percentage calculations of each of the 20 students within the study on Day 1.

### DAY 1 (food)

<table>
<thead>
<tr>
<th></th>
<th>Face #1</th>
<th>Object</th>
<th>Face #2</th>
<th>Words</th>
<th>Face #3</th>
<th>total</th>
<th>Calculation</th>
</tr>
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<tbody>
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### DAY 1 (no food)

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<th>Words</th>
<th>Face #3</th>
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<th>Calc.</th>
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Table 4: Raw Data displaying test scores and percentage calculations of each of the 20 students within the study on Day 2.

### DAY 2 (no food)

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### DAY 2 (food)

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