The Effects of Flavor of Chewing Gum on Memory

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Abstract

Study aids have been researched significantly to try and adapt a way of studying to be the most beneficial to people. One aid that has been shown to benefit cognitive functions is chewing gum. While it is known that mastication can produce some of these functions, it is unknown if any other factors are in play. Many studies have shown that chewing gum can benefit cognitive functions, but does the flavor of chewing gum play a part in this process? This study can improve upon this idea by showing what influence flavor has in the process. Approximately 40 Northwest Missouri State University undergraduates will be assessed with flavored and unflavored chewing gum to show whether the hypothesis that flavor will result in an improved ability for short-term memory recall is supported. They will be split into two equal groups, one with each previously mentioned type of gum, and asked to memorize a set of words. After a few minutes, they will be asked to spit their gum and write down as many words as they can remember. Results will be based on comparison of scores of the group with flavored gum to the one with flavorless gum.

Keywords: chewing gum, memory, flavor, short-term, recall
Chewing gum has been around since the mid-nineteenth century. Nowadays you can find chewing gum at almost every general store or gas station that you would come across. Gum is commonly chewed in a variety of different environments throughout the day. Some chew gum while at work, some chew gum while at school, and others chew gum around the house. Estimates of exactly how much chewing gum is consumed per capita is between the low of 168 sticks per year and a high of 300 sticks; one stick chewed every couple of days (Allen et al., 2008).

Along with the chewing habits that people have, there are also a variety of flavors that can be picked between. People can differ upon when they like chewing gum best. They can differ upon their favorite flavor of the gum as well. It is known that chewing gum has a positive effect on cognitive ability. It has been seen on Positron Emission Tomography (PET) scans oxygen levels increase in the blood, when chewing is ongoing, in areas intertwined with the Hippocampus. The Hippocampus is linked to memories. Therefore, chewing gum will lead to an increase in memory performance (Rickman et al., 2011). Prior research has shown that mastication increases heart rate, brain blood flow, and the activation of the prefrontal cortex (Davidson, 2011).

Chewing gum is said to impact alertness. Vigilance is regarded as the state of alertness such that a person is able to both detect and respond to pre-determined, small, and randomly occurring changes (or targets) in the external environment (Morgan et al., 2014). Vigilance can be accessed through various means. Bakan-type experiment tests are great for accessing vigilance, these tests require one to continually update short term order memory. In one recent experiment where chewing gum while studying was examined, researchers focused on how the
chewing gum would affect alertness and test performance. There were two experiments conducted in this research study. In the first experiment, gum was given to one group before they were given a twelve page paper over the heart to study for twenty minutes. After that, they were given two, twenty question tests that were timed for ten minutes each. The same procedure was used for the control group. In the second experiment, gum was given to one group and then they were to self study math problems. After this, they went over four worked problems and attempted four practice problems. Then they had a math test of twenty questions. The same procedure was used for the control group. For the first experiment, results showed that the chewing group had a higher level of alertness for the pre-lesson and the post-lesson. They also had a higher average terminology and comprehension score (Ginns et al., 2018). For the second experiment, the chewing group had an overall higher level of alertness than the control group. The chewing group also had an average higher total test questions correct and they took less time on the test (Ginns et al., 2018). These results support our additional information that chewing gum can improve cognitive functions. Chewing gum in general has been reported to affect cognition, alertness, and processing speed positively (Jang et al., 2015).

From examining prior research, it has been shown that chewing gum can create an increase in cognitive functioning, more specifically memory functions. But what types of memory does it improve? In one specific research study, a mastication intervention over a three month period was conducted. The purpose of this article was to study the influence of mastication on cognitive function in healthy older adults. They hypothesized that mastication could potentially improve cognitive ability after a 3-month period. Participants were shown items before the chewing started, in between, and after the three month period. Participants that were not in the control group were to chew a piece of gum for ten minutes, three times a day, for
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three months. All participants had two clinic visits before and after the intervention where they conducted the Mnemonic Similarity Task. They were to report if the item looked new, old, or similar to what they had seen before using the Mnemonic Similarity Task. Using this measurement, it was shown that those who chewed the gum for three months had significant improvements in recognition memory (Kim et al., 2019). Another research study that showed improvement on a certain type of memory was conducted using the Cognitive Drug Research computerized battery and computerized Serial Subtractions tasks. Participants were randomly assigned to three different experimental conditions including chewing (sugar-free gum), sham chewing (mimicking chewing movements), and quiet control (no gum or chewing movements). Participants were presented with Word presentation, immediate word recall, picture presentation, simple reaction time, digit vigilance, choice reaction time, spatial working memory, numeric working memory, delayed word recall, word recognition, and picture recognition. Using these measurements, the results of the study showed that there is evidence that chewing gum can improve episodic memory and working memory (Wilkinson et al., 2002).

The component of gum that is going to be the focal point of this experiment is taste. Chewing gum and flavor have not been previously investigated independently (Johnson & Miles 2008). It is not known whether there is a correct flavor of gum that should be used to enhance cognitive ability. While finding the best flavor of gum could be troubling because of the lack of resources and the countless number of gums that exist; it is possible to see if one flavor of gum is more effective than another or simply if flavor plays a role at all in cognitive function. If it was possible to find out the best flavor for a gum and cognitive functioning, then that flavor of gum could be chewed in situations where a cognitive ability would need to be enhanced for a particular reason. For sake of this experiment, mint flavor in particular will be tested since other
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studies have since shown experimentation with mint flavor. Not just gum, but the mint flavor has been investigated in other memory experiments dealing with an actual candy mint paired with drinking water. This makes the mint flavor a prime candidate for our experiment. The main problem arising is that it is difficult to tell if it is the gum itself or the flavor of the gum that has a prominent effect on memory recall. In one particular experiment there was evidence of an effect of either receiving gum or the mint flavor on memory recall. To further solve this problem, expert researchers believed that further experimentation needed to be done (Johnson, 2008).

Along with flavor, possible extracts could be added to gum to improve cognitive function. This was shown in a rat trial where *Ferula asafoetida* was shown that in high doses (400 mg) memory was improved significantly compared to a control (Adiga et al., 2012). Other experiments have also shown that rats can also improve memory significantly with other extracts. In a particular experiment, the extract *Boswellia papyrifera* was given to a set of rats involved in a memory maze and they had a positive correlation with memory (Farshchi et al., 2010). Since the rat is a common model organism used to compare to humans, there could be a correlation if given the proper experimentation.

This could in turn wind up being a major study tool that could help students with tests and even people in career paths that need to retain any sort of knowledge. Gum could be the perfect study aid as it has shown that it can improve recall. Studies have shown that people who chew gum have a higher recall rate when it comes to immediate recall than those who do not chew gum (Baker et al., 2004). By separating taste, it is possible to delve into the effects of flavor. Through manipulation it is possible to tell if flavor is a variable to consider or not. If it is not then mastication could be the only factor that is responsible for the enhanced cognitive abilities.
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Recent studies have shown that when people chew gum, it causes an increased effect on sustained attention (Tucha & Simpson, 2010). This can cause a relation to a higher cognitive ability. Many factors of chewing gum come together to formulate the beneficial effects. These benefits can vary, but chewing gum in general has been reported to affect cognition, alertness, and processing speed positively (Jang et al., 2015). It is likely that since gum has shown in past experimentation that it can affect these things, then with the right experimentation processes then it could be found that memory could be affected as well. Multiple experiments have shown that with testing gum has shown positive correlation with scores. With these higher scores it can be understood that the test takers were at a better potential to be able to recall proper information if they were exposed to the gum in the experiment. Although it is possible that different parts of chewing gum can influence the effects, our primary focus is to see if flavor has a factor more than any other would. We are predicting that pairing the flavor with a specific action that the brain will form a contextual dependent moment for that flavor. This will allow for you to be able to recall what information was being studied while chewing the gum. It is hypothesized that the presence of a flavor will result in an improved ability for short-term memory recall.

Method

Participants

Participants will be undergraduate students who are enrolled in general psychology at Northwest Missouri State University. 40 undergraduate students will be included for the study and will be split randomly into two groups of 20. The participants are expected to be around 18 or 19 years of age with demographics expected that match the demographics of Northwest Missouri State University.
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Participants will be acquired through the Sona program. Our study will be displayed on this program for students to participate within for credit in psychology courses. The sample will be a nonprobability sample with convenience sampling.

Materials

Short-term Memory Word List Recall

This word list will be used to measure the rate of memory recall ability in participants. This list will consist of 20 disyllabic words (see Appendix A). Baker et. al (2004), an expert level experiment, used a similar word recall list in their study on chewing gum and memory. The words selected for the inventory were chosen by the present researchers based on lists of disyllabic words that were accessible via the internet. This assessment is designed to accurately measure how many words can be recalled. This assessment can be scored by counting the amount of words properly recalled out of the 20 possible disyllabic words. Spelling is not to be counted against the participant.

Demographics

Demographics of the participants will be measured with a self-report survey composed of 4 questions created by the authors of this study (see Appendix B). Questions include: (1) What is your gender? Participants will write in their preferred gender. (2) What is your age in years? Participants will write in their current age. (3) What is the race that you identify with? Participants will select the race they identify with or write one in. (4) What is your class standing? Participants will select their class standing or write one in.

Procedure
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Once all participants have entered, they will immediately be given a consent form (see Appendix C) before being debriefed (see Appendix D). Each participant will then be given their pre-assigned type of gum, mint or flavorless along with the memory test on paper. They will be told to keep this paper face down until instructed to do otherwise, which will be shortly after everyone has received the gum and paper. Following, they will be told to begin chewing, flip the paper and attempt to memorize the words on the page (see Appendix A). They will spend one minute doing this. After that minute, they will be asked to flip their paper and spit their gum. Participants are asked to spit out their gum so our research can assess if the taste of gum affects their learning and memory recall, not the act of chewing itself. Our research also wants to avoid the possibility of the taste of gum interfering with the consolidation after learning or before the initial recall. Once the papers are all flipped over, one of us will start a three minute timer. During that time, we will collect papers and bring a trash can for them to spit their gum into. One of us will hand out the demographics surveys along with a pencil, which they will fill out during that time. At the end of three minutes, one of us will take the demographics surveys (see Appendix B) from them and hand them a blank piece of paper. They will be given a minute to rewrite all the words they remember. After a minute is up, participants will hand in all of their materials and be released.

**Proposed Analysis**

The descriptive analyses that need to be calculated for the demographic variables in the experiment are the following. For age, the most statistically valid central tendency would be mean. For gender, the most statistically valid central tendency would be mode. For race, the most statistically valid central tendency would be mode as well, and for class standing the most statistically valid central tendency is the mode. The preliminary analyses that will be conducted
are the skewness test, correlations, and a manipulations check analysis. We are hopeful that a skewness test will show that our dependent variable, memory, is distributed normally and will work well in our experiment. The statistic will be calculated and hopefully fall between -2.00 and +2.00. Correlations will be conducted between memory and all of the demographic variables. We will expect there to not be any correlations of memory with age, gender, race, or class standing. We expect the alpha values to be above the standard 0.05 ensuring that there is not significant correlation between the variables other than the independent variable. The last of the preliminary analyses that will be run is the manipulation check analysis. This will show that we did manipulate the participants by asking the question “What flavor of gum did you chew during the experiment?” at the end of the experiment. We expect all participants to be able to identify if they had received mint flavored gum or non-flavored gum. For the main analysis the test that will be conducted is the independent samples t-test. Variables involved in the t-test will be the flavor of gum chewed and memory. The purpose is to ensure that there is a difference between the memory variable in the mint flavor group and the non-flavor group. The statistic that we will be calculating is the mean memory score between each group. We are expecting that our experimental hypothesis is supported by showing that this test will have an alpha of 0.05 or less to show that the average mean from each group is significantly different.
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References


Appendix A

Disyllabic Word List

polar  Tiger
party winter
bamboo listen
wisdom gallon
travel finger
marvel cereal
symbol design
concert sunrise
fortune player
baseball keyboard
Appendix B

Demographics Survey

Instructions: Please answer the following questions to the best of your ability. Your responses are anonymous and will be kept confidential.

1. What is your age in years? _______________

2. What is your gender? _______________

3. What is your race? Select all that apply:
   a. American Indian or Alaska Native
   b. Asian
   c. Black or African American
   d. Native Hawaiian or Other Pacific Islander
   e. White/Caucasian
   f. Other: _______________

4. What is your class standing?
   a. Freshman
   b. Sophomore
   c. Junior
   d. Senior
   e. Other: _______________
Title of Project: The Effects of Chewing Gum Flavor on Memory

Principal Investigator: Megan Monroe, 816-645-9474, s529748@nwmissouri.edu

Advisor: Bradlee Gamblin, 660-562-1012, bgamblin@nwmissouri.edu

Purpose of the Study: The purpose of this research study is to examine the effects of gum flavor on memory.

Procedures to be followed: You will be given either mint-flavored or flavorless gum, which you will chew while trying to memorize a list of words. After a certain amount of time, you will be asked to spit your gum and return the paper. You will then fill out a demographics questionnaire. After doing that, you will be given a blank sheet of paper, on which you will write as many words as you remember from the earlier list.

Risks: Apart from allergic risks, there are no risks in participating in this research beyond those experienced in everyday life.

Benefits: By participating in this study, you may learn more about how chewing gum affects your memory.

Duration: This study should take approximately 10 minutes to complete.

Statement of Confidentiality: The questions you will be asked do not ask for any information that would identify who the responses belong to. Therefore, your responses are recorded...
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anonymously. If this research is published, no information that would identify you will be included since your name is in no way linked to your responses.

**Right to Ask Questions:** The researchers conducting this study are Sammy Robertson, Brayden McMillen, Megan Monroe, Reagin Klein, and Dylan Seese. You may ask any questions you have now. If you later have questions, concerns, or complaints about the research please contact Megan Monroe at 816-645-9474 during the day.

If you have questions regarding your rights as a research subject, you may contact the Northwest Missouri State University Institutional Review Board at (660) 562-1196. You may also call this number with problems, complaints, or concerns about the research. Please call this number if you cannot reach research staff, or you wish to talk with someone who is an informed individual who is independent of the research team.

General information about being a research subject can be found on the Institutional Review Board website by following this link: [http://www.nwmissouri.edu/fsenate/irb/index.htm](http://www.nwmissouri.edu/fsenate/irb/index.htm).

**Compensation:** You will receive 1 credit of research participation toward your PSYC 100 or 200-level course.

**Voluntary Participation:** You do not have to participate in this research. You can stop your participation at any time. You may refuse to participate or choose to discontinue participation at any time without losing any benefits to which you are otherwise entitled.

You do not have to answer any questions you do not want to answer.
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You must be 18 years of age older to participate in this research study.

Completion and return of the study implies that you have read the information in this form and consent to participate in the research.

Please keep this form for your records or future reference.

Appendix D

Script

1st:
“Hello, thank you for taking time out of your day to participate in our study, if you would like to further your participation in the study to receive credit, please fill out the informed consent statement in front of you.”

2nd:
“Today, we are going to have you study a list of words while chewing gum and then have you recall as many words from the list as you can to study the effects gum flavor has on short-term memory. Please refrain from using cell phones or other forms of distraction, it is important that you give the study your full attention. There is a paper faced-down in front of you along with a stick of gum. You will have one minute to study the list of words in front of you. Please open the stick of gum and start chewing. You may now flip the paper open. You have one minute to study.”

3rd:
“Time is up. Please flip your paper over. We will come around with a trash can for you to spit out your gum. Now we are going to collect your list of words and give you guys a demographic survey. You have three minutes to complete this. Please remember that everything in this study is anonymous and you may withdraw your participation at any time.”

4th:
“Alright, now that three minutes is up, we are going to go around and collect your surveys. We will also be placing down a new stick of gum and a blank piece of paper and a pencil. Please do not touch anything until instructed to. When we say you can start, please write down as many words from the list as you can remember. You have one minute to complete this. Please use the full amount of time to write down as many words as possible. When the time is up, we will have you spit your gum out, leave your papers face down, and then you are free to leave. Please open
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your stick of gum and start chewing. You can now start writing down what words you can remember.”

Debriefing Form:

“Thank you for completing the study and for your participation. The true nature of this study was to see if there was a correlation between gum flavor and memory recall. We appreciate you taking your time to further our research.

If you have any questions or concerns, please contact Dr. Bradlee Gamblin at bgamblin@nwmissouri.edu”