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Context Dependent Effects of Chewing Gum on Learning in Undergraduate Students

Delaney Mendoza

Clemson University

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Benjamin Stevens

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Abstract

Recent research has demonstrated support for the belief that chewing gum can enhance various cognitive processes related to learning, but most studies have utilized recall tasks that deal with selective attention and working memory. This experiment investigates performance on a recall test that better represents realistic learning materials in order to test whether chewing gum produces a strong enough context to have context dependent effects on learning. Of the 30 college undergraduates who participated, the group that chewed gum for eight minutes while reading a small essay and while completing 10 comprehension questions did not score significantly higher than the group who only chewed gum during the reading, even though there was a slight trend in the data to that effect. These results do not provide support for the notion that chewing gum produces a strong enough context dependent effect to affect learning.

Context Dependent Effects of Chewing Gum on Learning in Undergraduate Students

There is a belief among students that writing in the same color ink, listening to the same song, or even chewing gum can aid concentration and influence cognition. This belief remained essentially untested until Wilkinson, Scholey, and Wesnes (2002) showed that chewing gum could lead to improved performance on tests of immediate and delayed recall of words. In addition, chewing gum appeared to improve both spatial and numeric working memory (Wilkinson et al.). These findings may be of practical relevance given that chewing gum is used world-wide, with the US having the highest rate of consumption as of a 1999 study by Britt, Collins, & Cohen who found through a survey of 584 university students, of which 87% reported that they chewed gum at least occasionally.

Baker, Bezance, Zellaby, and Aggleton (2004) hypothesized that chewing gum can aid learning and lead to context-dependent effects so that recall is hampered when there is a change in context. Upon randomly splitting their participants into four groups (gum at learning and recall, gum at learning and no gum at recall, no gum at learning and gum at recall, no gum at learning or recall), they found that groups with consistent conditions at both learning and recall had significantly higher recall scores than the groups with condition changes on the recall test of 15 words 2 minutes after learning and again at 24 hours after learning. In addition, Baker et al. (2004) found higher scores related to consistent condition that required participants to chew gum, rather than not. They concluded that gum chewing gum was strong enough to produce a context dependent effect.

This study will continue to research this phenomenon and is interested in whether the act of chewing gum is a significant enough context to produce context dependent effects on learning. If chewing gum can invoke context-dependent effects, it is predicted that chewing gum at both

learning and recall will produce superior performance to chewing gum only at learning. Upon manipulating the presence or absence of chewing gum at recall (independent variable), I would expect that the subjects in the condition that requires the chewing of gum at both learning and recall will score significantly higher on the recall test (dependent variable), showing that there is a context dependent effect induced by chewing gum.

Method

Participants

The study selected 30 people to participate, 11 males and 19 females, all aged 18-22, collected from a convenience sample of Clemson undergraduate students and friends close to the researcher. Participants were informed of the procedure they would be going through, but not the hypothesis, prior to consenting, as well as being assured their results would remain anonymous. There was small goodie bags offered as reward to encourage participation.

Materials

A form including learning materials and recall tests were drafted by the researcher using Google Forms. The Form had a brief introduction, laying out the directions for the task, shown at the beginning.

Following the introduction, on the same screen, there were questions used to determine the demographic of the participants. The first one asked for the participant's age range, given the options "18," "19," "20," "21," and "22." The second demographic question asked for their gender, with "Female," "Male," and "Prefer not say" as the options, as well as an option titled "Other" that allowed participants to type in their gender if what they identify as was not a provided option.

Following the introduction screen, there was a screen with the message, “Please unwrap and begin chewing the gum that is next to your place card.” All participants had this message.

The following screen had a reading for the participants to complete, followed by three multiple-choice comprehension questions. The next screen provided instructions to remove the gum, then provided instructions for the distraction activity (a snack of 10 pretzels and a small bottle of water as well as 25 simple math questions).

The next screen prompted the participants to chew another piece of gum or disregard the message, depending on whether they were given another piece of gum.

Following this screen was another that gives instructions to complete ten comprehension questions as well as the questions themselves. This Form is presented in its entirety at the end of the report as Appendix 1.

Finally, a script was created to send to potential participants by email. This gave some information about the study, enough to gain informed consent, and then requested a response for whether the individual was willing participate or not (Appendix 2). Then another script was sent to give the participant the information regarding when and where the study will take place, as well as their participant number (Appendix 3).

By keeping the learning and recall materials identical, giving immediate comprehension questions, as well as testing in the same location and time for all participants, the researcher hoped to establish internal validity by reducing the effects of any confounding variables, as well as screening for the participants’ attention to the material. The researcher also hoped to decrease the carryover effect by having the participants all participate in a short math quiz, drink a bottle of water, and eat a snack in between the learning and recall.

Design

This study will use an independent measures experimental design. The independent variable was whether the participant received mint flavored gum during learning and recall, or just during learning. The dependent variable was performance on a recall test after learning and a distraction activity.

Procedure

The participants were emailed a request for participation. Those who responded were assigned a participant number. These numbers were then used in a random number generator to assign the participants a condition.

The researcher met with all the participants at 3pm on Sunday during one week in April, in a classroom in Hendrix Student Center. The participants were seated at the place associated with their participant number and instructed to begin the Google Form at the URL given on their participant number place card.

The students entered the URL on their place card, read the instruction screen and filled out the demographic questions. Then they were instructed by the researcher to move to the next screen where they were instructed to begin chewing the gum in front of them, then progress to the next screen. There was a short reading, which the participants had 10 minutes to learn, next they spit out their gum and ate a snack of pretzels and drank water while completing a ten-question distraction activity. After five minutes, they were instructed by the researcher to move on and either begin chewing a second piece of gum or disregard, before completing ten comprehension questions. They were then instructed to submit their form.

Results

As shown in Figure 1 and Table 1, participants in the gum at learning and recall condition answered more questions correctly (M = 6.00, SD = 1.648) than the participants in the condition that chewed gum only at learning and not at recall (M = 4.80, SD = 1.781). An independent samples t test was computed to compare the groups and though it approached the standard threshold for significance, the results were not statistically significant, $t(28) = 1.916$, $p = 0.066$. Because Levene's Test was not significant, equal variance was assumed (Table 2). Those who chewed gum at both learning and recall did not have significantly higher scores than those who only chewed gum at learning, thus, the data fail to support the notion that chewing gum produces a context dependent effect on learning.

Discussion

The results from the experiment conducted on 30 undergraduate students at Clemson University did not support the expected hypothesis. The findings showed that participants in the consistent context condition (those who chewed gum at both learning and recall) had a higher rate of correct answers on the learning test than those in the inconsistent context condition (those who chewed gum only at learning), though there was not a significant enough difference for this to support the expected hypothesis.

The expected hypothesis was that there would be significantly higher success on the learning test for the participants in the consistent context condition, showing that chewing gum at both learning and recall is a strong enough context to produce context dependent effects, however this was not the case even though the data pointed to a small trend in this direction. This failure to produce significant results could be attributed to multiple factors, including the relatively small sample size. Because only 30 students were selected to participate, then

randomly assigned to a condition, it is quite possible that 15 participants per condition was too small, considering most of the literature on this phenomenon cites experiments with larger sample sizes.

An additional alternative for these findings is that the time spent chewing gum was not long enough to establish a context for the participants. Thus, the presence or lack thereof of chewing gum at recall would not have a context dependent effect, as the brain did not recognize a strong enough context to begin with.

A final alternative explanation for these findings can be attributed to the demographics of the participants themselves. The researcher selected these participants from a convenience sample of her friends and acquaintances at Clemson University. This could have had an effect on the results as these individuals all have a grade point average at or above 3.0, and at least one third are members of the honors college. Due to the higher-than-average academic success of these participants, the context dependent effects of the chewing gum could have been present, but too weak to fully show in the results, as all individuals are able to perform highly on academic tasks.

The most likely of these explanations for the lack of statistical significance in the results of this study is the small sample size. The time spent chewing gum to establish a context should have been enough, as shown by other experiments testing similar theories, and the academic predisposition of participants seems not entirely likely to skew results enough to change the significance of the results. The sample size, however, was much smaller than other experiments of similar nature that were found during the researcher's literature review. If repeated, this study should acquire more participants with the hopes of securing strong enough results to have statistical significance.

References

Baker, J. R., Bezance, J. B., Zellaby, E., & Aggleton, J. P. (2004). Chewing gum can produce context-dependent effects upon memory. *Appetite, 43,* 207–210.

Britt, D. M., Collins, F. L., & Cohen, L. M. (1999). Cigarette smoking and chewing-gum use among college students. *Journal of Applied Biobehavioural Research, 4,* 85–90.

Wilkinson, L., Scholey, A., & Wesnes, K. (2002). Chewing gum selectively improves aspects of memory in healthy volunteers. *Appetite, 38,* 235–236.

Table 1

Group Statistics as Shown in Output from SPSS Statistics

	condition	N	Mean	Std. Deviation	Std. Error Mean
numcorrect	1	15	6.00	1.648	.425
	2	15	4.80	1.781	.460

Table 2

Results of an Independent Samples T Test Run in SPSS Statistics on Data from the Recall Task

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
numcorrect	Equal variances assumed	.386	.539	1.916	28	.066	1.200	.626	-.083	2.483
	Equal variances not assumed			1.916	27.832	.066	1.200	.626	-.083	2.483

Figure Captions

Figure 1. Participant scores on recall test in relation to the condition to which they were assigned.

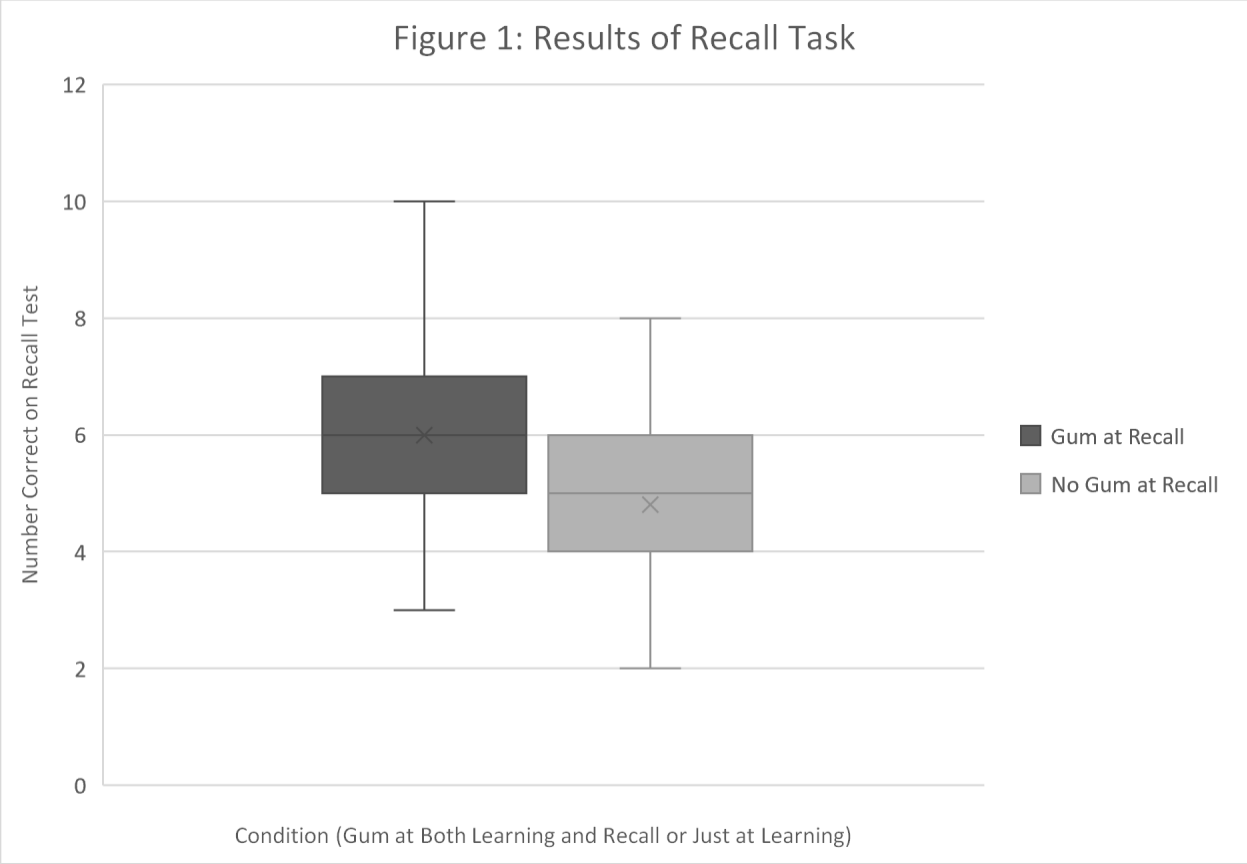
Figure 1: Results of Recall Task
12
10
8
6
4
2
0
Number Correct on Recall Test
Gum at Recall
No Gum at Recall
Condition (Gum at Both Learning and Recall or Just at Learning)

Appendices

Appendix 1: Google Form

Context-Dependent Effects On Learning

Please follow the directions on each page and submit the form when you are done. Thank you for participating!

Please answer the following questions to the best of your ability.

* Required

1. Please enter your participant number *

2. What is your age? *

Mark only one oval.

- 18
- 19
- 20
- 21
- 22

3. What is your gender? *

Mark only one oval.

- Male
- Female
- Prefer not to say
- Other:

Please unwrap and begin chewing the gum that is next to your place card.

Proceed on to the next screen upon the cue of the proctor

Please do your best to learn this information for the next eight minutes, then proceed to the next screen upon the cue of the proctor.

Eleanor of Aquitaine was one of the most powerful women of the Middle Ages. Duchess of Aquitaine in her own right, she would go onto become queen-consort of France and later queen of England.

Eleanor was the elder daughter of William, tenth Duke of Aquitaine. The exact date of her birth is unknown, but she was raised in one of Europe's most cultured courts and given an excellent education. She later became an important patron of poets and writers.

The death of Eleanor's only brother, and of her father in 1137, left her with a vast inheritance. At just 15-years-old, she had suddenly become the most eligible heiress in Europe. That same year she married Louis, heir to Louis VI of France, who shortly afterwards became king as Louis VII. The couple had two daughters.

In 1147, Eleanor accompanied her husband on the Second Crusade, traveling to Constantinople and Jerusalem. The Crusade was a failure and relations between Eleanor and her husband, already poor, deteriorated even further. Eleanor's failure to produce a son contributed considerably to this tension, and in 1152 they were divorced.

Two months later Eleanor married Henry of Anjou, who in 1154 became king of England. The couple had five sons and three daughters. For nearly two decades, Eleanor played an active part in the running of Henry's empire, traveling backwards and forwards between their territories in England and France.

In 1173 two of Eleanor's sons involved her in a plot against their father, and as a result Henry imprisoned her. After Henry's death in 1189, his eldest son, Richard I, ordered his mother's release. Despite her age (now in her mid-sixties, which was considered elderly in the 12th century) Eleanor became very closely involved in government. In 1190, she acted as regent in England when Richard went to join the Third Crusade. She even played her part in negotiations for his release after he was taken prisoner in Germany on his way home.

In 1199, Richard died and was succeeded by Eleanor and Henry's youngest son, John. Eleanor's role in English affairs now ceased, although she continued to be closely involved in those of Aquitaine, where she spent her final years. She died on 31 March 1204 and was buried in the abbey church at Fontevrault next to Henry II.

Please answer the following to the best of your ability.

You will be instructed to move on by a cue from the proctor.

4. What year was Eleanor born? *

Mark only one oval.

- 1131
- 1204
- 1107
- The birth year of Eleanor is not known

5. What two kings was Eleanor married to? *

Mark only one oval.

- The King of England and the King of France
- The King of France and the King of Italy
- The King of Germany and the King of England
- None of the above

6. What crusade did Eleanor go on? *

Mark only one oval.

- The First Crusade
- The Second Crusade
- The Third Crusade
- The Fourth Crusade

If you have been chewing gum, please remove it now. Proceed to the next screen upon cue from the proctor.

Instructions for second activity.

In front of you is a small snack of pretzels, as well as a bottle of water. During the next fifteen minutes, please eat all of the pretzels and drink all of the water while you complete the simple math problems that are below. Please move on at the cue of the proctor.

7. 6-3 *

8. 15-8 *

9. 7+9 *

10. 4*10 *

11. 11-1 *

12. 5+9 *

13. 4*3 *

14. 11-4 *

15. 8+12 *

16. 0*6 *

17. 6+6 *

18. 9-5 *

19. 3*7 *

20. 18-17 *

21. 15-3 *

22. 12+4 *

23. 17-5 *

24. 19+6 *

25. 13+6 *

26. 1*13 *

27. 17-4 *

28. 7+11 *

29. 8+8 *

30. 4*3 *

31. 5-2 *

If there has been another piece of gum placed next to you, please begin chewing that now. If not, disregard this message. Please proceed to the next screen at the cue of the proctor.

Please answer the following to the best of your ability. You will have eight minutes.

Please select the submit button at the cue of the proctor.

32. What year was Eleanor born? *

Mark only one oval.

- 1101
- 1112
- 1107
- None of the above

33. how many daughters did Eleanor have with her first husband? *

Mark only one oval.

- 1
- 2
- 3
- None of the above

34. How many sons did Eleanor have with her second husband? *

Mark only one oval.

- 3
- 4
- 5
- None of the above

35. What country was Eleanor Queen Consort to? *

Mark only one oval.

- England
- France
- Both of the above
- None of the above

36. Which of her husbands imprisoned Eleanor? *

Mark only one oval.

- Henry II
- Louis VII
- Both of the above
- None of the above

37. What crusade did Eleanor go on? *

Mark only one oval.

- ◯ The First Crusade
- ◯ The Second Crusade
- ◯ The Third Crusade
- ◯ None of the above

38. Which forms of art was Eleanor a patron of? *

Mark only one oval.

- ◯ Writers and Painters
- ◯ Sculptors and Poets
- ◯ Writers and Poets
- ◯ None of the above

39. Which son released Eleanor from imprisonment? *

Mark only one oval.

- ◯ Richard
- ◯ John
- ◯ Henry
- ◯ None of the above

40. What territory did Eleanor inherit as a young teen? *

Mark only one oval.

- Anjou
- Aquitaine
- Andorra
- None of the above

41. What year did Eleanor die? *

Mark only one oval.

- 1201
- 1205
- 1214
- None of the above

Appendix 2: Info Letter

Context-Dependent Effects on Learning

March 8, 2022

Dear Participant:

I am a student enrolled at Clemson University in Psychology 3100. As part of requirements for the course, data are collected for a research study. The purpose of this study is to determine whether there are context-dependent effects due to environment on learning in college students. Thirty students who are at least 18 years old have been invited to participate. As part of the research procedures, you will be asked to complete a short reading, followed by a snack and a brief and simple math worksheet, then a multiple-choice learning assessment. This will take place in about one hour on one Saturday or Sunday in April. Information from this study will allow us to know more about how environment effects learning in college students. There are no risks involved.

This study will take about 1 hour on one Saturday or Sunday in April to complete. This study is anonymous so no one will know which scores are related to which individual.

Participation is voluntary. You can refuse to answer any questions at any time and can withdraw without any penalty. Return of the attached questionnaire is deemed consent to participate in the research study.

The instructor overseeing this student research study is Dr. Ben Stephens, who may be contacted at bstephe@clemson.edu. If you have any questions regarding your rights as a research participant, you may contact Dr. Cynthia Pury at cpury@clemson.edu or 864-656-7876 (please mention this is in reference to a Psychology 3100 project).

Thank you for your assistance in this study.

Delaney Mendoza

Appendix 3: Follow up letter

Context-Dependent Effects on Learning

March 20, 2022

Dear Participant:

Thank you for agreeing to participate in this study. We will meet at 3pm on Sunday, April 17th, in the ballroom of Hendrix Student Center. Please bring your laptop with you. There will be goodie bags provided at the end as a thank you for participating.

Your participant number is: _____

Thank you for your assistance in this study.

Delaney Mendoza