CHEWING GUM ON ADOLESCENTS
The Impact of Chewing Gum on Adolescents

Niccolo Hurst, S5Ena, Luxembourg 1 (mentor, Mr. Bennett).

Abstract

There is a controversy over chewing gum. Not only does it cause litter, but teachers and parent often believe that it’s bad for students. While students are told not to chew, there is usually no justification provided.

To explore this question, I reviewed the scientific literature. Research shows that chewing is actually good for dental hygiene as the saliva removes food particles from the teeth. However, it can have a negative effect on the digestive system since chewing releases acids in the stomach as the brain anticipates food. This excess acid can lead to stomach problems.

The general conclusion is that chewing gum is not to be recommended due to its effects on the body, though the evidence does not point strongly one way or the other. However, research has also showed that chewing might be helpful for short-term memory and concentration due to the increase in insulin, and blood levels in the brain that follows mastication.

I tested this by giving simple memory tests (visual and audible) to a sample of 89 students. Some were asked to chew gum during the test, while others did not. The results of the audible test (measuring alertness) were no different. However, the chewers performed better with the visual test (short-term memory) and this was statistically significant (p-statistic of 0.0017 for a two-tailed Student’s T-test of whether the means were the same). The chewers’ marks were 12% higher than the non-chewers.

In conclusion, chewing may help you to memorise facts just before a test! The problem is you may have forgotten it all again in the next 10 minutes. The issue lies after the test in where you put the chewed gum...
The Impact of Chewing Gum on Adolescents

Introduction

Chewing gum is nowadays a global phenomenon. Not only is it in every supermarket, and on every bus-stop pavement, but also in a substantial amount of students’ mouths. It is very common at school to see students with gum in their mouth chewing away even though they are constantly told not to by teachers. This made me wonder “what is the impact of gum on a student?” To start, I reviewed a substantial amount of literature on the subject.

Internet Research

Internet research shows that chewing gum can have a negative effect on the teeth and jaw. It is shown (as from www.huffingtonpost.com and www.theholykale.com) that chewing gum with sugar increases the probability of cavities and blood sugar levels, similarly to sweets. Doing so, the sources state that the combination of the two factors increases the possibility of diabetes, heart disease, obesity and numerous chronic dietary problems. Furthermore, it is said that chewing increases the likelihood of some jaw disorders, and wear and tear on the cartilage surrounding the jaw points and the facial muscles. The overuse can not only lead to pain and damage to the cartilage, but also causes stress on the muscles which can lead to intermittent headaches.

Chewing gum has a negative effect on the stomach. When chewing gum, the process of mastication signals to the brain that food is going to be eaten, this provokes the secretion of acids in the stomach. The increase of acidity in the stomach increased the possibility of stomach aches and general stomach problems.

Even chewing sugarless gum can have a negative effect on the body. Most sugarless chewing gum contain artificial sweeteners, the most common being Aspartame. As shown in www.theholykale.com, Aspartame has the leading number of official complaints made to the FDA (Food and Drug Administration) than any other food or additive combined. Two-thirds of the complaints are neurological and one-third gastronomical. Aspartame is a known excitotoxin, literally exciting cells to a state of death. Excitotoxins can also cause a loss of brain synapses and connecting fibres. A review conducted in 2008 by scientists from the University of Pretoria and the University of Limpopo found that consuming a lot aspartame may inhibit the ability of enzymes in your brain to function normally, and may lead to neuro-degeneration. Obviously, the quantity of aspartame in gum is very small, but it is a very discussed and controversial sweetener. Aspartame has also been shown to increase the possibility of cancer and diabetes as shown in the article by www.thehuffingtonpost.com.
Another disputed artificial sweetener is sorbitol. Research from the Charité Universitätsmedizin in Berlin (as shown from www.nhs.uk) demonstrate that large quantities of the sweetener can act as a laxative, hence increasing the chance of diarrhoea. Furthermore the source shows that large quantities of Sorbitol can be associated with severe weight loss and abdominal pains.

**However, chewing some sugarless gums can have some positive effects on the mouth.** The article on chewing gum by www.mouthhealthy.org showed that chewing sugarless gum can prevent tooth decay. The chewing of sugarless gum increases flow in the saliva, which washes away food and other debris, neutralises acids produced by bacteria in the mouth and provides disease-fighting substances throughout the mouth. Increased saliva flow also carries with it more calcium and phosphate to help strengthen tooth enamel. Furthermore, chewing gum can temporarily satisfy hunger, which can lead to a reduction of extra snacks.

The article by www.huffingtonpost.com show that some gums contain a product called Xylitol that is used to reduce cavities and plaque. Xylitol is a natural sweetener that is considered “tooth friendly” by dental professionals, as it can ‘starve’ the negative micro-organisms that damage teeth, allowing the teeth to re-mineralise faster. Another additive that has been used in the production of more healthful chewing gum is called calcium lactate. When added to gums that contain xylitol, it can further aid in the re-mineralisation process of enamel surfaces.

**More surprisingly, chewing gum can help concentration.** Research from the University of Cardiff (as shown on www.sciencedaily.com) demonstrated that chewing gum can lengthen concentration span. Chewing gum can benefit some areas of cognition, but the results are most significant with short term memory.

**And it is claimed that chewing gum can improve memory.** Several sources (such as www.bbc.co.uk, www.newscientist.com, www.forbes.com, and www.sciencedaily.com) state that chewing gum has a positive effect on memory, specifically short term memory. In tests scientists found that the ability to recall remembered words was improved by 35%. There is no known reason to why chewing gum improves short term memory, but the two re-occurring hypothesis are that, firstly, chewing gum raises the heartbeat, which causes more oxygen and nutrients to be pumped into the brain. Secondly chewing gum triggers the production of insulin, which stimulates a part of the brain involved with memory. When people chew, the body releases insulin, which is a conditional response that occurs in anticipation of a meal. The brain is a ‘hungry organ’. Although it accounts of 2 % of body weight, the brain uses about half of the energies resources. Along these lines, the act of chewing tricks the stomach into thinking it is about to receive food.

Other research showed that there was only a noticeable improvement of short term memory when chewing 10-20 minutes before the tests. This is an act of ‘warming up’ the brain. The researchers think that this improvement in brain power is due to the chewing gum provoking a phenomenon called “mastication induced arousal”. This arousal turns the brain on just before test taking and gets more blood (and therefore energy-giving sugar) flowing to the head. The researchers found that a burst of gum chewing before testing improved a student’s performance on several tests. The effect was strongest right after starting to chew gum, demonstrating that the benefits last a short amount of time.
Chewing gum can increase alertness. Several other articles (such as www.ncbi.nlm.nih.gov and www.dailymail.co.uk) dismissed improvement in short term memory but explained that only alertness was increased. Studies show that chewing gum can boost alertness up by 10%, according to these sources. They also say that there is no significant improvement in short term memory (www.livescience.com).

Other studies have also found that gum to be an effective anxiety buster, though the reasons why are not quite clear (www.forbes.com). A 2009 study found that under laboratory conditions, chewing gum resulted in reduced cortisol levels (cortisol referred as stress hormone) and a reduction in overall anxiety.

**Probably the most prominent effect that adolescent chewing gum has is on littering.** Chewing gum is a huge littering problem, due to the fact that it is not degradable food, and that it is costly and time consuming to remove. People seem to have the reflex to simply spit it out rather than throwing in a bin. In 2005, a company called Defra estimated that British local authorities spent a total of £150 million per year on gum removal, or three times more per gum blotch than each stick cost when fresh. London spends £8,500 each time to de-gum Trafalgar Square alone. This is also a huge problem in schools, where gum can be found under desks and chairs in almost every classroom.

After compiling and observing all of the research, some clear results were found concerning the effect of chewing on a student. Firstly, chewing gum containing sugar has mostly negative effects on the body, and is recommended to be avoided. Some sugar-free gum can have positive effects on the teeth, but the most common artificial sweetener (aspartame) can be dangerous in large quantities.

Chewing gum can have positive effects on short term memory, concentration and alertness, even though these effects are still speculative, and the reasons are not yet known. These factors can be very useful for a student in test conditions. It must be stressed that for every review backing up the possible benefits of gum, there was another review claiming that gum has no benefits on the brain.

From the internet research, I attempted to organise some experiments, but some problems had risen:

Firstly, it is very difficult to observe the physical effects of gum on the mouth, teeth, brain and stomach using school apparatus, so the experimentation had to be focused on the possible positive aspects of chewing gum (concentration, short term memory and alertness). Furthermore, these possible benefits are likely to be more influential in a studying environment like school, where concentration, alertness and short term memory are key.

**Method**

Based upon this research, I designed an experiment to assess the impact of gum on mental tasks for students. I inferred from internet research that a visual and audible test would give variation in
results. So I decided to split the experiment between 2 tests: one being a visual test, and another audible test. This way I could observe the differences and possibly find different effects of gum on students. Prior to the test, I asked the students to write down their age and sex to further know about the students I was testing. I also had to search for a chewing gum to use on all of the students. Due to its popularity in the school, I decided to use Wrigley’s Spearmint chewing gum, and used it for all of the classes I tested.

Before starting the experiment to each class, I told the students to chew for about 10 minutes before the experiment started whilst I explained the purpose of the experiments, and set up the tests. This was done to allow time for the effect of chewing to provoke ‘mastication induced arousal’.

The first experiment was aimed at examining the effect of chewing gum on short-term memory and concentration, and was more focused on the visual aspect. In a specific sample, I gave half the class some gum, and not to the other half so that I could compare results. The gum was given out at random. Then, I gave the class a small set of digits that they had to remember in 20 seconds. Gradually, the number of digits were increased, and therefore increasing the difficulty of concentration and short-term memory. The test went from 3 up to 11 digits and back down, giving a total of 18 sequences to remember. The test was always presented to the class via a projector and all the class conditions were the same. Annex 1 shows the first test.

The second experiment (performed sequentially after the visual test) was aimed at examining the effect of chewing gum on alertness, and was more focused on the audible aspect. The students that already had gum continued to chew, and the experiment conditions were kept the same as the previous one. In this experiment I read out a sequence of 20 random numbers ranging from 1 to 9, and the students had to spot how many times I had read out an odd number, followed by an even number, followed by an odd number (hence giving the pattern odd-even-odd). This process was done with 4 different sequences, giving a total of 4 sequences per student. In one of the classes (19 students) I was unable to read all 4 sequences due to illness, and the teacher (Mr Bennett) finished reading the final 2 sequences. One class was not able to do the audible test (17 students).

In total I tested 89 students, with ages ranging from 13 to 18. All of the students were in the English section with English as their mother tongue, apart from 19 students that were 5th year English SWALS. The students were either 3rd years, 4th years or 5th years. I needed to find tests of similar difficulty to receive fair results, but the amount and depth of tests had to be limited to fit a 30 minute time period, to avoid disrupting the classes. All of the students had similar test conditions.

There was a common observation between all of the classes that the students designated with gum didn’t actually chew whilst during the experiment. This is because they said they found it difficult to concentrate and chew simultaneously, and so I repeatedly encouraged the students to chew throughout the experiment in case they forgot. Annex 2 shows an example of a student’s test.

The two following photos show students writing down their answers for the first test, the first class being year 3, and the second year 4.
Results

After doing all the tests, I proceeded to the most laborious part of the experiment: marking all 89 students’ answers and organising them. I created graphs and made calculations to observe the data.

Firstly I put all of the results in one graph: the light green representing the visual test (marked out of 17), and the black representing the audible test (marked out of 4).

The data shows that the sample of students with gum was larger than that of the students’ not eating gum. Furthermore, the sample of students chewing gum had a higher maximum in the visual test (14 out of 17, performed by 4 students), and an equal minimum of 6, but only had 1 student, compared to the 2 in the non-chewing group.

The audible test proved to be difficult, as the results show multiple students receiving 0 out of 4. However, the sample of students’ chewing gum had a larger range. Fewer students participated in the audible test due to the time restrictions of one class. This meant that 72 students participated in the audible test instead of 89.

It is difficult to draw any conclusions from this graph, as it is just a broad general view of the data.
From this data I decided to look at the results in more detail, specifically the mean and standard deviation of both the visual test and the audible test, starting with the visual test.

1) Visual Test

This graph shows the mean mark of the students chewing and not chewing gum in the visual test. The graph demonstrates that the students chewing gum have a distinct higher mean, where on average a student performs over 1 mark better when chewing gum than a student that isn’t. This might be thought to reinforce the hypothesis that chewing gum can have a beneficial effects on the brain as far as short-term memory is concerned (the visual test was aimed towards short-term memory and concentration).

So at first glance results could support the ‘mastication induced arousal’ description found in the internet research, where chewing 10 minutes prior to the test warms up the brain as it increases blood circulation to the brain.
To see the validity of the results presented by the mean, I decided to observe the frequency distribution of the visual test results to look at the spread of the data.

\[
\text{Standard deviation} = \begin{cases} 
\text{Students with gum} & = 1.9940 \\
\text{Students without gum} & = 1.5399 \\
\text{1.99 (2 d.p)} & = 1.54 (2 d.p)
\end{cases}
\]

Both the frequency distribution graph and the standard deviation show that the data of the students’ chewing gum is more spread out with a larger standard deviation.

Carrying out the two-tailed Students T-test (with the calculator at [http://studentstest.com](http://studentstest.com)) produced a p-statistic of 0.00169. This level indicates a very strong presumption against the hypothesis that the means are the same.

Chewing gum does help short-term memory and concentration. The score for chewers increases by 11.8%.
2) Audible Test

This graph of the mean results of students chewing and not chewing gum in the audible test shows that the students chewing gum did indeed have a higher mean than the students not chewing gum but only by a minute amount (0.01).

These results also show that chewing gum has almost no effect on alertness, which was what the audible test was focused on.

There are some observations to be made from during the experiment. It must be said that a smaller amount of students participated in the audible test (72), this is however a large enough number of students to make a comparison (only 17 students short of the other test).

Furthermore, during one of the tests I did not read out all of the sequences, due to a difficulty to talk, therefore the teacher supervising continued the last 2 sequences. This, slight alteration is most probably insignificant to disrupting in the results.

Overall, the two slight modifications did not seem to cause any problems in the results.

As in the previous test, to see the validity of the results presented by the mean, I decided to observe the frequency distribution and standard deviation of the audible test results to look at the spread of the data.
**Standard Deviation**

- Students chewing gum = 1.1206
- Students without chewing gum = 0.9327

Both the frequency distribution graph and the standard deviation show that the data of the students’ chewing gum is very slightly more spread out, with a slightly larger standard deviation.

Carrying out the one-tailed Students T-test (with the calculator at [http://students.test.com](http://students.test.com)) produced a p-statistic of 0.49 (the p-statistic for the two-tailed test is 0.98). This level indicates no presumption against the hypothesis that the means are the same.

Therefore, the results show that the benefits of chewing gum are insignificant, but this could be due to the very short boost of the chewing gum at has worn off by the time the second test started (the tests were performed sequentially, with chewing before the first visual test).
Conclusion

The general conclusion is that chewing gum is not to be recommended due to its effects on the body, though the evidence does not point strongly one way or the other. I was not able to test the effects of gum on the physical body due to difficulty in testing with school apparatus. However, research showed that chewing might be helpful for short-term memory, alertness and concentration due to the increase in insulin, and blood levels in the brain that follows mastication, called ‘mastication induced arousal’.

I tested this by giving simple memory tests (visual and audible) to a sample of 89 students. Some were asked to chew gum during the test, while others did not. The results of the audible test (measuring alertness) were no different, with the mean and the standard deviation showing insignificant results. The chewers performed better with the visual test (short-term memory and concentration) and this result was statistically significant. The test results increased by 12% for the chewers.

Therefore, the following conclusions can be made:

- Chewing gum has a negative effect on the stomach – and gum with sugar damages the teeth.
- Chewing gum creates huge littering problems in urban areas and schools, as it is not easily removed.
- Chewing gum does not improve alertness and/or the effects of chewing wear off rapidly.

However, chewing can improve and short-term memory and concentration.

So chewing may help you to memorise facts just before a test! The problem is you may have forgotten it all again in the next 10 minutes. The issue lies after the test in where you put the chewed gum …..

I would like to thank Mr Bennett and Mr Mallon for their support and for being able to interrupt their classes to perform the experiment. A further thank you to the classes participating:

-3ENa

-4ENa, and 4ENb

-5ENa, and 5Enb

Observations and References

Obviously the accuracy and detail of these experiments is debatable, so to have thorough results the test would have to be done under stricter conditions. Furthermore, with more capabilities as far as apparatus is concerned, it would be interesting and beneficial to observe the physical effects of gum on the brain, stomach and mouth during the experiments. Even observing differences in blood circulation could be interesting if possible.
References:

“Chewing gum helps you concentrate for longer” from www.bps.org.uk

“Chewing gum helps you study for longer, study says” from www.sciencedaily.com


“Chew yourself a better brain” from www.forbes.com

“Chewing over a problem? Chomping on gum can boost alertness by 10%” from www.dailymail.co.uk

“Gum-Chewing Improves Test Performance” from www.livescience.com

“Chew your way to a better brain” from www.news.bbc.co.uk

“Chewing gum improves memory” from www.newscientist.com

“Does Chewing Gum Improve Memory?” from www.healthyliving.msn.com

“Chewing gum health scare” from www.nhs.uk

“Chewing Gum” from www.mouthhealthy.org

“Chewing gum can produce context-dependent effects upon memory” from www.elsevier.com

“Why Chewing Gum Isn’t Great for Your Health” from www.drbenkim.com

“Chewing Gum: Causes health issues?” from www.theholykale.com

“Mouth Health: Is Chewing Gum, Good or Bad?” from www.huffingtonpost.com
Annex 1

Note: This following annex does not contain the entire PowerPoint used for the test; it contains some sample of what students saw projected.
65DB

now write it down
1D7A385

7

now write it down
2E69F438

now write it down
64D2A5C7H18

now write it down
3BD5A1689E

10

now write it down
31H8

now write it down
2A7

now write it down
Annex 2
Chewing Gum ✓
Age: 13 and 6 months
Born: 21/07/2000
Gender: Girl / Female

Visual:
1) 65DB ✓
2) G3F7B ✓
3) BE6887 ✓
4) 1D7A385 ✓
5) 2E69F438 ✓
6) 7218C8H5C
7) 8296D13A1 ×
8) 832947B9637
9) C2S289C5421 ×
10) 3B2A1986A ×
11) D6939218C ×
12) A3D92186 ×
13) 5H942C2D ×
14) 36H88B ×
15) 92E43 ✓

Audible:
1) HHHH1
2) HHH 1
3) HHH H11
4) H11

\[ \frac{8}{17} \]

\[ \frac{0}{4} \]