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## *Does chewing gum affect short-term memory?*

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Does chewing gum affect short-term memory?

## **Abstract**

Over the last 10 years there's been a lot of research on whether there is a link between chewing gum and a higher cognitive function. Several different researches have showed that a significant affect exist whereas others have shown no such results. The purpose of this research is to get further results on the subject, by using word recall after verbally presenting the words. Repeated measures where used on a random group of volunteers from the age of 18. There short-term memory was tested in four different recall tests, where two were with chewing gum and two were without. The results didn't show any statistically significant findings between chewing gums and an improvement in memory recall. Further testing needs to be done on the subject.

## **Keywords:**

Psychology, short-term memory and chewing gum.

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## Introduction

The memory is an important part of our life. Without it we wouldn't be able to remember anything, not be able to read or even speak a sentence. The short-term memory, which is a part of the early memory, filters and process information. Without the short-term memory there wouldn't be a long-term memory and no way for learning to take place. The short-term memory sends the selected most important information through to the long-term memory where it's stored (Passer et al, 2009). It's been showed that the more information on a subject that can come in to the short-term memory, the more information makes it through to the long-term memory and the faster we learn a task or a subject (Nikolić et al, 2007).

The information that enters the short-term memory is normally around  $7 \pm 2$  units and only stays in the short-term memory for about 20 seconds before it's either forgotten or gets encoded into the long-term memory. By repeating a word, it can stay longer in the short-term memory then the 20 seconds. When recall is tested, most people remember the words in the beginning and the end the best. This could be explained by the fact the words in the beginning goes into the short-term memory and gets repeater more times than the rest. The words in the end are fresher in the memory and that's why they are easier to recall then the other words. Another way to remember more items is to put them together, called chunking. For example instead of remembering each word, the words can be put into sentences and each sentence is then one unit. (Passer et al, 2009).

It has also been shown that the attention is a direct result of the short-term memory. With an affective memory comes the ability to control the incoming information as well as the ability to focus the attention on a selective problem. Without the ability to select impute, an unnecessary storage of information will take place and this takes focus away from the important tasks. (Fukuda et al, 2009). The conscious attention has a limited capacity that way the short-term memory has to choose what information to send forward. The choice is usually done automatically or habitually and differs between individuals. The limitation is a way of making sure the brain doesn't get over stimulated by the constant stream of new information that's perceived. (Lundh et al, 1992)

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## **Background**

Is there a link between memory and chewing gum? It's difficult to answer since previous research show very different results. Some show improvement, whereas others show an impairment of the memory or no significant results at all (Tucha et al, 2012). What has been showed is that chewing gum affects the body. For example it prevents stress as well as high cholesterol and blood pressure (Smith, 2009), which in term could affect cognitive functions like memory.

Research that's been done on chewing gum over the last 10 years have included several different cognitive functions, like memory, learning and attention. When looking at attention, Scholey et al. (2009) and Johnson et al (2011) found that chewing gum increased alertness following a stressor. Tucha et al (2004) found that chewing gum only affects specific aspects of attention, for instants sustained attention was improved by the chewing gum. Alertness and flexibility however were negatively affected. Wilkinsson et al (2002) didn't find any significant improvement in attention when chewing gum.

Some studies have shown that there was no difference in learning between subjects who chewed gum compared with those who didn't chew gum (Allen et al, 2008). Whereas other studies have shown an improvement on the participant's learning (Tucha et al, 2012). When testing math performance on 8<sup>th</sup> graders Johnson et al (2012) showed that the students in the chewing gum group scored higher in the standardised math test then the control group did.

The memory has also been studied and it showed that chewing gum significantly improved performance on standardised tests of both working memory and episodic memory. The results were for both immediate and delayed word recall. (Wilkinson et al, 2002; Stephens et al, 2004). When looking at context-dependent memory Baker et al (2004) found that chewing gum aided its affect, however the flavour may have accounted for some of the affects.

There are also research showing the opposite results, like Tucha et al (2004) who didn't find any improvement on working memory functions when chewing gum. Kozlov et al (2012) even showed that chewing gum impairs short-term memory for both item order and item identity. There are also studies showing no significant affects between context-dependent memory and chewing gum (Johnson et al, 2008; Overman et al, 2009)

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One explanation for the different results could be the different brand of gum used, due to the difference in resistance. Suzuki et al (1994) showed that different consistencies of gum gave different patterns of cerebral blood flow and heart rate changes. Another explanation is an increase in arousal and heart rate when chewing gum (Wilkinson et al, 2002). Onyper et al (2011) explained the result as an effect of mastication-induced arousal. They also theorised that an interference affect due to the sharing of resources might be an explanation on the tests with no improvement when chewing gum. Stephens et al, (2004) theory were that insulin got secreted as a response to the anticipation of a nutritional load, which in term promoted glucose uptake. Gums effect on mood and cortisol levels has also been looked at as an explanation. It showed that chewing gum had a positive effect on mood during stress and that these results were mirrored by changes in salivary cortisol. The performances on the tasks were significantly better in the group that chewed gum (Scholey et al, 2009).

All these factors could give different neurocognitive affects and in the end affect memory. Time also seems to be a factor at least according to Onyper et al (2011). They showed that the performance only was enhanced when the chewing of gum was done 5 minutes prior to the cognitive testing, and only on some of the cognitive domains.

When looking at the methods used in the previous studies, only one study have previously used word recall when the words have been verbally presented. Most of the studies have used visual presentation when word recall was tested. A few others studies have used verbal presentation but then word recall wasn't tested. In those studies a long story was told and general parts were to be recalled (Tucha et al, 2012). The use of different methods can also be part of the different results shown in the earlier studies, but without further studies with different methods it's unclear how the method affects the studies.

## **Purpose**

The main purpose of this study is to see whether there is a significant effect on memory when chewing gum. To test the short-term memory a recall test will be administered. The words will be verbally presented, since this method has only been tested once before when looking at

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memory and chewing gum. The previous study using verbal testing, showed an impairment of the memory, which hasn't been showed previously.

A second purpose is to find out if the effect on the memory is positive or negative, if there is an affect.

### **Hypothesis**

The hypothesis is that there is a significant affect between chewing gum and memory. This is based on the previous research, that a lot of them show an affect.

The second hypothesis is that the affect is positive. This hypothesis is made because most of the previous research shows a positive effect.

### **Delimitations**

To limit the thesis to a reasonable size it will only focus on short-term memory and it will only test one kind of flavoured gum.

By using repeated measure the same participant can be tested both with and without chewing gum, which saves time.

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## **Method**

The present experiment was conducted to examine relations between short-term memory for words and chewing gum. Four tests were conducted. Each test comprised of 13 different words which were read individually to each participant. Immediately following each test participants were asked to recall as many words as they could. The first two tests were conducted without the participant's chewing gum. The second two tests were conducted while the participant chewed gum. In previous research verbal presentation of word has only been tested once before, whereas visual presentation has been used several times (Tucha et al, 2012). Some of the studies in which stimuli have been presented visually, have shown an improvement in short-term memory when participants chewed gum, whereas others showed no effects on the memory. However, in the study where verbal presentation was used, the study showed that chewing gum impaired the short-term memory (Kozlov et al, 2012).

### **Method choice**

The method used is repeated measure. The reason this method was chosen was to eliminate the possible group differences that could occur when two groups are tested against each other. The upside of this method is the high validity, meaning it measure what it's supposed to. The internal validity can be threatened by regression threat and maturation test, meaning the participants change during the test and tends to regress toward the mean. (Shaugnessy et al, 2012). Another risk with this method is the practise affect, meaning that the participant's performance can be due to practise instead of the chewing gum (Shaugnessy et al, 2012). Lundh et al, (1992) writes that the more experience we have of a certain task, the less attention it requires. This would mean that more energy can be put into remembering words. So if the practise affect comes into play, then the test scores should improve with each test.

### **Participants**

The participants were random shoppers out on the town in Malmö. They were asked if they had a couple of minutes to spare, and would participate in a short test about memory and chewing gum.

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They did not find out the hypotheses before the test. The study comprised of 10 females and 12 males. All the participants were Swedish and no one had problem with hearing or writing. The reason only people that speaks Swedish were chosen, was to eliminate any language barriers. All the participants were over the age of 18 (ranging from 19-79) and none of them got any compensation other than a “thank you”.

### **Stimuli**

13 random words were told to the participants in the four tests. The risk with using different words for each of the four test, is that some of the words may be more difficult to remember and can therefore affect the results. For instance longer words are more difficult to remember then short words. The same goes for unknown word, which are harder to remember then familiar words (Hulme et al, 1995). The chosen words are everyday well known words; with the mean length of 4, 6 and ranging from 3 to 10 letters in Swedish. The words used in the present study are shown in Appendix 1, along with the words translated into English.

### **Design**

Each participant was tested in a quiet room so that they could focus on the task at hand. As well as prevent any interruption in the participants thought process. The first two tests were performed without chewing gum and afterwards two more tests were performed, this time with chewing gum. The reason two tests were made under the two conditions, were to minimize the risk of the result being due to the 13 words. Doing more test could lead to the participants getting tired as well as increasing the risk for the practice affect. The reason different words were used in each test, was to eliminate repetitions and giving the participant a greater chance to remember the words. Between each test the papers with the participant’s answers were collected and changed out for a new bland paper. This so the participant’s couldn’t change anything in their previous answers, if they were to remember more words later.

The tests with the gum were performed last, so it wouldn’t affect the results for the test without chewing gum. If tested the other way around the gum could affect the cognitive functions and the



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affect wouldn't have had time to fade before the test without gum was going to be performed. That would have made the results unreliable. The gum was sugar-free, to make sure the sugar itself didn't cause the changes in performance. The tests were in Swedish since all the participants were Swedish.

The age of the participant's wasn't noted. However their age was checked to make sure they were over the age of 18. Studies have shown that age has an insignificant impact upon the short-term memory (Bäckman, 2008), and should therefore not affect the result of this study.

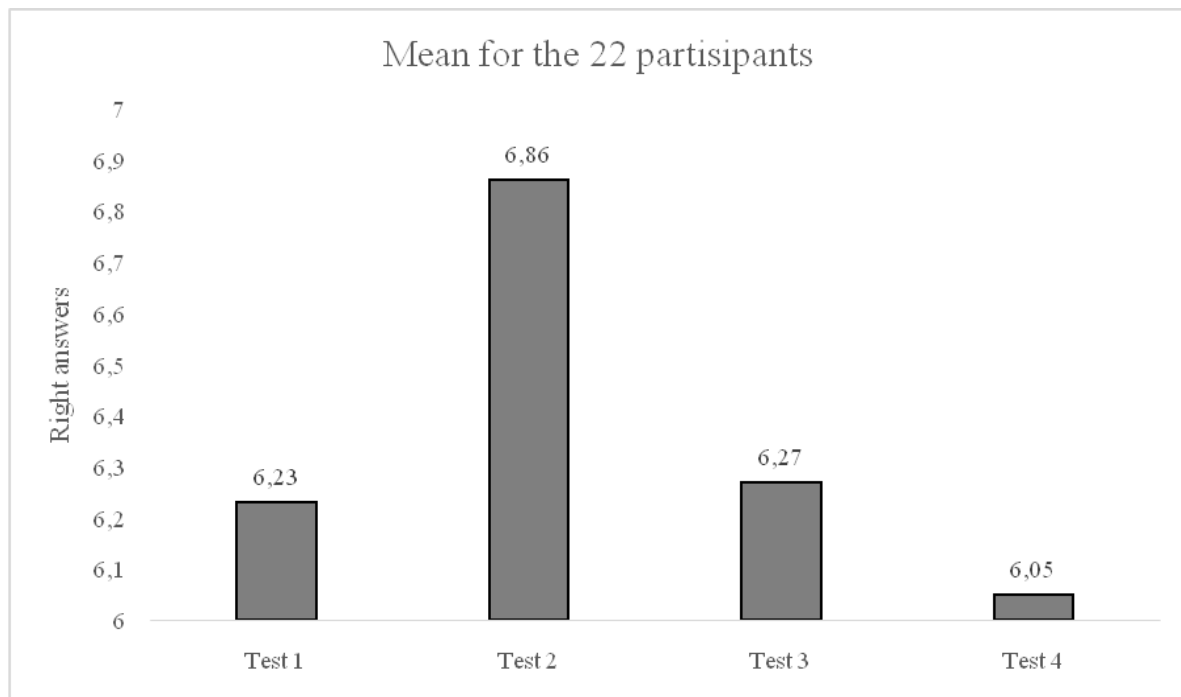
## **Procedure**

Each participant was tested in a quiet room so that they could focus on the task at hand. At the beginning of their session each participant was given instructions verbally about how the experiment would proceed. Afterwards the participants were asked if they had any questions or if there was anything they wondered before starting the first test. Then started the first test and the participants got to hear the first 13 words. Immediately after all the words had been said, participants were required to write down as many of the words as they could remember (not necessary in order). The participant then got a new blank paper for the next test and the procedure was repeated. After the two first tests a single piece of sugar-free mint gum (Brand: V6) was given to the participant. They were asked to chew on it for about a minute, before the next two tests were performed. The importance of chewing the gum throughout the next two tests was emphasised. After that the third test started, followed by test 4, both done in the same manner as the first two, with the exception of chewing gum. Each test lasted for about 2 min and the whole experiment 10 minutes in total for each participant. All of the participants heard the same words and in the same order. The words were read from the top and down. Starting with the first column labelled "test 1" (See Appendix 1). After the last paper had been collected, after test 4, the answers were looked at and put into a worksheet in SPSS. Only the correct answers were counted. Misspelled words got looked at more closely, to make sure the word they written down was the right ones. Some of the participants had written down similar word, words with the same meaning, but those were not counted either. Analysis of variance (ANOVA) with two within-participant factors was used to analyse the findings.

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## Result

The results of the Experiment are shown in Figure 1. The data were submitted to an analysis of variance (ANOVA) with two within-participant factors [no chewing gum (test1, test2), chewing gum (test3, test4)]. This analysis failed to reveal statistically reliable main effects of no chewing gum,  $F(1,21) = 1.408, p > 0.5$ , partial  $\eta^2 = 0.063$ , and chewing gum  $F(1,21) = 0.417, p > 0.5$ , partial  $\eta^2 = 0.019$ . Likewise, no statistically reliable interaction obtained between no chewing gum and chewing gum,  $F(1,21) = 3.426, p = 0.078$ , partial  $\eta^2 = 0.140$ . The significance level is very close to 0,005 in the analyses between gum and no gum, indicating there is a trend.



*Figure 1: The mean of the result from the four tests. Tests 1 and 2 were conducted without chewing gum tests 3 and 4 were conducted while participants chewed gum. Only the right answers were counted*

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## Discussion

The first hypothesis of this experiment was that there was going to be a significant effect on memory and chewing gum. The result didn't show any significant affects, but it did show a trend ( $p=0.078$ ). That could mean that chewing gum could have an effect on memory. Possibly if the conditions change a bit, it would be stronger. Like time, this has been shown to be a factor (Onyper et al, 2011). It could also simply suggest that there is no link, that this was simply just a trend in this case and might not show if someone were to do this study again. Since several of the previous studies haven't shown any significant affect, this study will strengthen their position in the on-going debate wheatear or not chewing gum can affect memory.

The second hypothesis was that the affect would be positive. When looking at figure 1, the affects seems to be negative. When testing without gum the performance improved in the second test. When testing with gum the performance were impaired in the second test. The previous study by Kozlov et al (2012), who used the same method, showed an impairment of the short-term memory too. This could suggest that the method used could affect the outcome. Without more studies using the same method, it can't be ruled out that the result might be affected by the choice of method.

One of the reasons for the results could be because a different brand was used and as Suzuki et al (1994) showed could have had an effect. As mentioned in the background there are several factors that seem to have an effect on the performance. For instants if the participants were focusing on chewing gum instead of the recall, the short-term memory had lesser resources to give to the recall (Onyper et al, 2011). Another factor that could come in to play is the use of gum in the participant's everyday live. The subject hasn't really been looked at, but people chewing gum every day could have other affects by the gum then people who never chew gum ordinarily.

When looking at the mean of the participants result, no advantage in memory function can be seen. If there were to be a positive link between chewing gum and memory then the mean between test 1 and 2 would be higher than the mean on test 3 and 4. The results show the opposite, but with only a slightly higher mean in the first to tests. The means are also very close to the number 7 (see figure 1), which is the average amount of word a person will remember

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(Passer et al, 2009). This would suggest that the test were measuring what it was supposed to and the result can't be explained by wrong testing. In the café of wrong testing the results would most likely have a mean a lot higher or lower.

The words used were everyday words that everyone knows what they mean. They were also relatively short and about the same length. All to eliminate the words being a factor that could explain the result, as previous research show (Hulme el al, 1995). When counting the words the participants had written down, only the correct answers were counted.

The participant's didn't know the hypothesis when doing the test. Eliminating the effect that information could have had on the performance. For instants, if the participants were told that they were to the better in the last two test, then it's possible they would be due to "stereotype threat". Meaning you act like you think you are supposed to.

To make the study more reliable a second experiment could have been done, this time with the chewing gum on the first two tests and then no chewing gum on the second two tests. That way it would show more clearly if the chewing gum had affected the results at all. A bigger group of participants can also give a more accurate representation of the population. As well as give the study a higher validity.

In conclusion, this study didn't show any significant affects between chewing gum and improvement of memory, only a trend. More research on the subject need to be done, especially using different methods.

### **Future studies**

The conflicting results shows that more research on the subject is necessary before a conclusion can be reached. The already existing research could be redone to strengthen the argument for or against the affects and for example change the method to see if the results come out differently. Further test of different kinds of chewing gum could also help explain the differences in result. As well as a test to see how people who regularly chews gum differs from people how normally never chews gum. It would also be interesting to see if there was any difference between sexes.

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## Appendix 1

Words used in the four test, A is in English and B is the words in Swedish.

A)

Test 1	Test 2	Test 3	Test 4
cat	Table	Tree	Rug
Car	Dog	Tooth	Lamp
Red	Green	Blue	Yellow
Glass	Bike	Horse	Rabbit
Chair	Picture	Door	Clock
shoes	Floor	Sandals	Lawn
Apple	Orange	Pear	Banana
Hand	Foot	Arm	Leg
Spoon	Fork	Knife	Napkin
Nine	One	Four	Seven
Pillow	Bowl	Blanket	Leaf
Baker	Fireman	Doctor	Plummer
Window	Fridge	Stove	oven

B)

Test 1	Test 2	Test 3	Test 4
katt	Bord	Träd	Matta
Bil	Hund	Tand	Lampa
Röd	Grön	Blå	Gul
Glas	Cykel	Häst	Kanin
Stol	Tavla	Dörr	Klocka
Skor	Golv	Sandal	Gräsmatta
Äpple	Apelsin	Päron	Banan
Hand	Fot	Arm	Ben
Sked	Gaffel	Kniv	Servett
Nio	Ett	Fyra	Sju
Kudde	Skål	Filt	Löv
Bagare	Brandman	Doktor	Rörläggare
Fönster	Kyl	Spis	ugn