

# Psychology IA

## Investigating the effect of visual context on the recall of text passages

Word count: 2289

Date of submission: 2021.10.25.

## Tartalom

Psychology IA .....	2
Investigating the effect of context on the recall of text passages .....	2
<b>Introduction</b> .....	2
Background .....	2
Operationalization .....	4
<b>Exploration</b> .....	4
Research design .....	4
Sampling Technique .....	5
Choice of Participants .....	5
Controlled variables .....	5
Choice of materials .....	6
<b>Analysis</b> .....	8
Descriptive statistics .....	8
Inferential statistics .....	9
<b>Evaluation</b> .....	10
Strengths and limitations .....	10
Suggestions for future improvement .....	12
<b>References</b> .....	13
<b>Appendices</b> .....	14
Appendix 1 – Raw data table .....	14
Appendix 2 – Procedure .....	15
Appendix 3 – Standard briefing note .....	16
Appendix 4 – Standard instructions .....	17
Appendix 5 – Copy of the consent form .....	19
Appendix 6 – Standardized text passage used in the experiment .....	20
Appendix 7 – Idea units in Hungarian .....	21
Appendix 8 – Standardized context picture .....	22
Appendix 9 – Calculations for descriptive statistics .....	23
Appendix 10 – Calculations for inferential statistics .....	25

## Psychology IA

### Investigating the effect of context on the recall of text passages

#### Introduction

##### Background

For our investigation, we chose to replicate Bransford and Johnson's (1972) original study, in which they similarly investigated the effect of context on memory. In the first experiment of that particular study, they examined the influence of context on the recall rate of a standard text passage. They divide their participants into 5 groups that experienced slightly different conditions. Two groups did not receive any context picture whatsoever, but one of them got to hear the recording of the text passage twice. One group received a context picture fully relevant to the text passage before listening to it, and another group after listening to it. Finally, that last group received a partially relevant context picture prior to hearing the text. Later on, the comprehension of the texts and the recall rate of idea units were assessed and conclusions were drawn.

This experiment is closely related to the Schema theory, and its results (that context generally enhanced recall rates) can be explained by this phenomenon. Based on Bartlett and Burt (1933) schema theory tries to explain some aspects of our memory formation and retrieval. It states that our memories are structured around schemas, which are defined as mental representations that organize our knowledge, beliefs and expectations based on perceptions and past experiences.

Since we are cognitive misers our brains prefer a utilitarian approach towards mentally exhausting tasks, like comprehension and memory formation. To ease the tasks of our mind,

we use relevant schemas to interpret information more easily in a simplified version. However, due to these simplifications, we are prone to make mistakes while using these schemas.

A special type of schemas is called event schemas, or scripts. These are representations about sequences of events that help us make sense of subsequential data and are usually originated from our everyday experiences. An example of this would be the script for washing our hands or ordering pizza. It has been shown in Bower et al. (1979) that these scripts are so powerful, that in some cases they can even modify our memories. In their experiment the schema of going to the dentist made participants remember certain steps, that was not even mentioned in the text they listened to and had to retrieve later.

Ultimately, our study aims to investigate, whether giving context before the coding of heard information into memories can already activate a script about giving a serenade and if this script will help our participants store the heard information immediately in the appropriate schema, therefore, making its memorization more effective and precise.

This is a relevant topic in our everyday life as well since as we are students, we always have to try to maximize our memory capabilities. If we came to the conclusion that prior context can help memory formation, we could alter our studying methods to include initial context information before going into great details about certain topics in order to enhance our efficiency.

## Operationalization

**Independent variable (IV):** Context – one group will receive a context picture (*Appendix 8*) before hearing the text passage, while the other will receive no context at all

**Dependent variable (DV):** Recall rate – the number of idea units they successfully recall from the original 13 during a free recall (paraphrasing allowed)

**Research Hypothesis (H<sub>1</sub>):** Being exposed to a picture (*Appendix 8*) that gives full context to a text passage (*Appendix 6*) before hearing the said text passage will increase the recall rate of idea units (*Appendix 7*) during a free recall compared to not being exposed to a context picture.

**Null Hypothesis (H<sub>0</sub>):** Being exposed to a context picture will not increase the recall rate of idea units during a free recall

## Exploration

### Research design

To test our hypothesis, we outlined a quantitative research with independent measures design, in which the allocation of the participants into the two groups and so into the two conditions was random. One group received a context picture prior to hearing the text passage, while the other group did not receive such a stimulus. We chose an independent sample design because using repeated measures would have created confounding variables in our case. Not only would the order effect interfere with our results since the memory capacity of our subjects can get easily depleted and they would not be able to perform as well the second time, but it would also be necessary, to introduce a new text passage with a new context picture as well. It would be very hard to find or create a text passage that has a similar comprehension rate as the original one, therefore it would affect our results.

### Sampling Technique

We used an opportunity sampling method because that was the most convenient to us. We asked a class if they would allow us to conduct the experiment on them during one of their classes and also reached out to their teacher who agreed to this.

### Choice of Participants

In our experiment, we used students from our school between the age of 18-19. Regarding gender they were heterogeneous, and our sample contained males and females in a similar ratio. This choice of participants was based on several aspects. First of all, they were the most easily available for us to conduct our experiment on and since they were all over the age of 18, we did not need parental consent from any of them. Additionally, since they were all from the same school it already assumes as prerequisite similar abilities to memorize things, therefore the chance of getting extreme recall values because of unusually bad or good capabilities was reduced.

### Controlled variables

**Time:** In every part of our experiment, time was controlled for both groups. They had the same one-minute long-filler activity and also the free recall was maximized at seven minutes for both groups as well.

**Environment:** Regarding the environment of our experiment both groups were held in very similar school classrooms with no decorations, but each had a smart board on which we could show them the picture and listen to the recording.

**Materials:** The text passage was played from a recording for both groups. We played attention to the adequate volume settings in both conditions. Furthermore, it was ensured that in the context receiving condition everybody could see the picture properly. In both cases for the free recall, they received a standard A5 white paper.

**Research bias:** To minimize the effect of research bias, the subjects were not told, whether we expect the context group to have a higher recall rate or not. Obviously, we could not keep it secret, which group they were in (context or no context). Furthermore, to decrease research bias, the researchers who assessed the free recall writings were not present at the actual experiment, did not know the participants personally, and could not tell, which group the writing they are assessing came from. In addition, every writing was assessed by two independent researchers and in every disputable case, a third researcher made the final choice. Doing so eradicated the possibility, that they will (even if subconsciously) skew the data to the desired outcome.

## Choice of materials

### *Text passage*

We used the original text from the study, but we decided to translate it to Hungarian since the mother tongue of our subjects was Hungarian. We thought that most of us memorize things in Hungarian, even if we heard them in English. Therefore, reading the passage out in English would also test how well our subjects can speak the language, which would be a major confounding variable. However, it is worth noting, that by translating the text, some of the previously ambiguous words became more straightforward, which may have affected our results.

### *Context picture*

Since we used the original text it was only natural, that we would use the original context picture as well which can be found in the Appendices. Not only was this easily available, but it paired well with the text, gave full context to it and was easily comprehensible.

### *Informed consent*

The informed consent was written by us and can be found in our Appendices. It was read out in front of our subjects with our introduction and orientation to ensure that everybody received the same information and that they have enough information, that they can make an informed consent about their participation to ensure the ethical conduct of our experiment.



## Analysis

### Descriptive statistics

The mean of the number of idea units correctly recalled were calculated for each condition alongside other statistical values which can be found in the following table:

	Experimental group <i>context condition</i>	Control group <i>no context condition</i>
Mean	5.07	3.69
Standard deviation	2.15	1.72
Mode	5	3
Median	5	3
Number of participants	14 (+1)	16

Table 1 - Descriptive statistical values

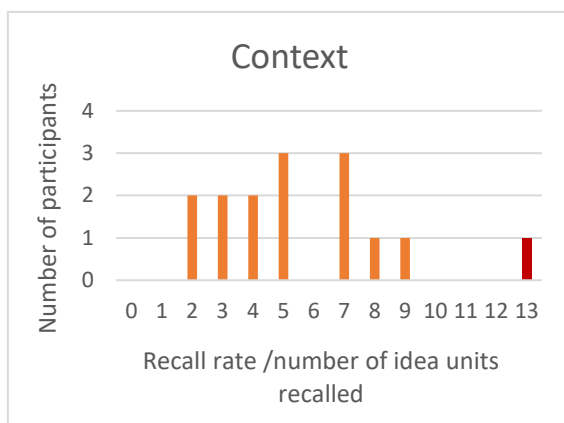


Figure 2 - Dispersion of recall rates in the experimental group

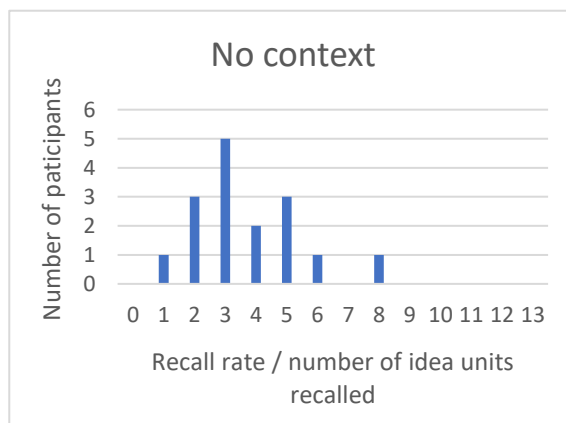


Figure 1 - Dispersion of recall rates in the control group

As it can be seen in Fig. 2, marked by a red bar as opposed to an orange one in our experimental group we had an extreme value of 13 idea units recalled. That particular participant did recall the whole text passage almost word-by-word and because of their outstanding performance we had to identify their recall rate as an outlier value, and it was not included in our calculations.

Based on these results we can conclude, that while the general tendency of our outcome was in line with the one reported in the original study, the recall rate in the context condition had

a lower average value than expected. However, we can see a clear difference between the two mean values (5.07 in the context condition compared to 3.69 in the no context condition). Furthermore, the standard deviations of our data sets were quite high as well (2.15 and 1.72), implying that our data points are very widespread which may influence the credibility of our results

To investigate, whether this difference is statistically significant, we need to conduct an inferential statistical test. By removing our extreme value, we can assume the normality of distribution in both conditions therefore we can use a parametric inferential test.

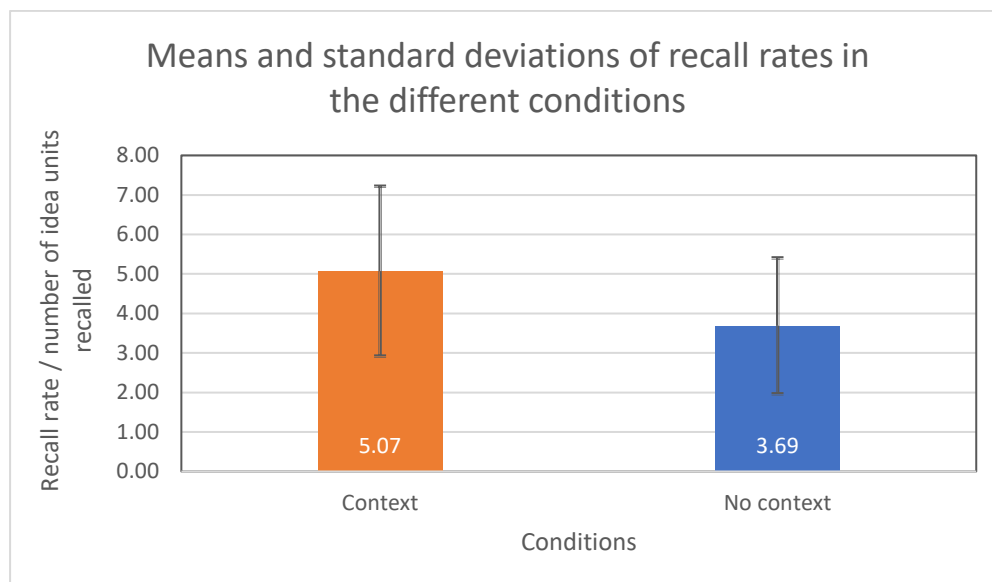


Figure 3 - Means and standard deviations of recall rates

### Inferential statistics

A one-tailed, unrelated t-test was conducted on our data sets. We used a parametric test because of its greater sensitivity and because we wanted to use the explanatory power of our ratio level data rather than reducing the level of measurement to ordinal with a non-parametric test.

The 14 participants who received context before listening to the text passage ( $M = 5.07$ ,  $SD = 2.15$ ) compared to the 16 participants in the control group who did not receive any context ( $M = 3.69$ ,  $SD = 1.72$ ) demonstrated significantly better recall rates of idea units,  $t(28) = 1.89$ ,  $p = .0347$ , one-tailed.

Considering our research hypothesis was that recall rates will be higher in the condition where the subjects are given a context picture prior to listening to the text passage we can see these findings suggest that our  $H_0$  hypothesis can be rejected and the  $H_1$  research hypothesis is supported.

## Evaluation

### Strengths and limitations

The fact that we use independent measures design could be mentioned as a strength of our experiment. Since every participant had to do the task once we did not experience any order effect, since they did not get for example tired during a first task which would have influenced their performance in a second task. Furthermore, it also eliminated the chance, that they would figure out our hypothesis hence acting differently during the tasks because of demand characteristics. On the other hand, the different capabilities of our subjects may affect our result, which can be identified as a limitation. However, to minimize these effects we used random allocation and therefore we can assume that the average memory efficiency in the two groups was approximately similar. As a modification, we could have used a memory test before dividing them into groups and allocated them into the two conditions so based on the test result to create even more similar groups. Additionally, more participants were needed than if it was repeated measures design because they could only do the task once, therefore twice as many people were needed.

Our opportunity sampling enabled us to easily reach a sufficient number of participants, but it came with its downsides. For example, since all of our participants were around the same age (18-19) and came from the same class our sample was not representative as participants were not randomly chosen, therefore, the ecological validity of the experiment is rather low, and our results only reflect the tendencies that can be observed in this teenager population. While the fact that these students came from the same school affected our ecological validity, since likely they had similar socioeconomic status, memory capabilities and intelligence, it also decreased the differences between our subjects ensuring a higher internal validity.

We also correctly realised, that by performing the tasks on the mother tongue of our participants we can eliminate a potentially confounding variable, namely the foreign language abilities. This way the language skills of our participants did not influence our outcome. However, since the translation already required us to interpret the text and rephrase it accordingly it cannot be ensured that the same level of comprehensibility was achieved as in the original English test.

Another strength of our experimental design was that the researchers who marked the free recall writings were not present at the time of the data collection, therefore they had no information whatsoever about the participants. Additionally, since two researchers marked the writings separately and their assessments were compared later, we could also eliminate the chance of random errors being made by the researchers during the evaluation.

Eventually, we can conclude from this investigation that at a  $p < .05$  level of significance exposing subjects between the ages of 18-19 to a context picture before listening to the text passage activated the proper scripts (event schemas) and increased their recall rates of idea units significantly compared to the condition where they did not receive any context. This phenomenon can be explained by the Schema theory.

### Suggestions for future improvement

For future improvement, I advise conducting the experiment on a representative sample in order to gain more knowledge about the general tendencies found in the whole of our society, rather than in an isolated, teenage group. Additionally, by increasing the sample size we can also minimize the chance of extreme values and other confounding variables skewing our data set.

## References

- Bartlett, F. C., & Burt, C. (1933). REMEMBERING: A STUDY IN EXPERIMENTAL AND SOCIAL PSYCHOLOGY. *British Journal of Educational Psychology*, 3(2), 187–192. <https://doi.org/10.1111/j.2044-8279.1933.tb02913.x>
- Bower, G. H., Black, J. B., & Turner, T. J. (1979). Scripts in memory for text. *Cognitive Psychology*, 11(2), 177–220. [https://doi.org/10.1016/0010-0285\(79\)90009-4](https://doi.org/10.1016/0010-0285(79)90009-4)
- Bransford, J. D., & Johnson, M. K. (1972). Contextual prerequisites for understanding: Some investigations of comprehension and recall. *Journal of Verbal Learning & Verbal Behavior*, 11(6), 717–726. [https://doi.org/10.1016/S0022-5371\(72\)80006-9](https://doi.org/10.1016/S0022-5371(72)80006-9)

## Appendices

### Appendix 1 – Raw data table

Context (idea unit recalled / pc.)	No context (idea unit recalled / pc.)
2	1
2	2
3	2
3	2
4	3
4	3
5	3
5	3
5	3
7	4
7	4
7	5
8	5
9	5
13	6
	8

Table 2 - Raw data table including outliers

Context (idea unit recalled / pc.)	No context (idea unit recalled / pc.)
2	1
2	2
3	2
3	2
4	3
4	3
5	3
5	3
5	3
7	4
7	4
7	5
8	5
9	5
	6
	8

Table 3 - Raw data table excluding outliers

## Appendix 2 – Procedure

1. A briefing was held about our experiment and we asked all the subjects, whether they are over the age of 18.
2. We collected their signed informed consent forms.
3. We divided the subjects into two groups through random allocation (by making them draw a paper from a pile with one of the conditions on it).
4. We showed the context pictures to one of the groups
5. We played a recording of one of us reading out the text passage slowly for both groups (making sure, everyone can hear the recording properly)
6. For one minute we made them count back from 60 to 0
7. After that, they were asked to recall all information they can remember and write it down on paper. 7 minutes were given for this part.
8. We collected the papers and marked them with their participant IDs. We also filled out a table indicating which condition they were in for each participant ID.
9. The collected writings were assessed by group members, who did not know the subjects and were not present at the time of data collection
10. Prior to assessing the efficiency of their recall, we divided the text passage into 13 idea units. Each idea unit is worth one point during the assessment. (we accepted the idea units in different wordings as well, as long as they had the same key meaning)
11. Every writing was examined and assessed by two group members separately, and eventually compared. If they did not match, we decided together, how much point to give for that writing.
12. Statistical data was calculated from the results.



## Appendix 3 – Standard briefing note

### **Briefing**

Hello everyone. You will be participating in a short psychology experiment regarding your memory. You will hear a short passage and be asked to recall as much from it as you remember. The experiment will be anonymous, and your results will be handled confidentially. You may withdraw from the experiment at any point. You will be handed consent forms to confirm your participation.

## Appendix 4 – Standard instructions

### **No-context group English translation:**

Now we will read you the instructions of the experiment. From now on until you are told otherwise please don't interact with your peers in any form. You will be handed a blank paper and a pen. After receiving these, please write down your participant ID on your paper. Then you will hear a short pre recorded text which you will have to memorise. After hearing the text you will be asked to count backwards from 60 aloud. Then you will have to write down all the information you remember from the text that you heard. For this you will be given 7 minutes. At the end of the 7 minutes you will have to put your pen down and let the researcher collect your paper.

### **No context group Hungarian:**

*Most felolvasom a kísérlet utasításait. Mostantól kezdve, amíg másképp nem utasítanak, kérek, semmilyen formában ne lépj kapcsolatba társaiddal. Kapni fogsz egy üres papírt és egy tollat. Miután megkaptad ezeket, kérek, írd le a papírra a résztvevő azonosítódát. Ezután egy rövid, előre felvett szöveget fogsz hallani, amelyet memorizálnod kell. Miután meghallgattad a szöveget, arra fogunk kérni, hogy számolj vissza 60 -tól hangosan. Majd írd le minden információt, amire emlékszel a hallott szövegből. Erre 7 percet kapsz. A 7 perc leteltével, kérek tedd le a tollat, és hagyd, hogy a kutató összegyűjtse a papírod.*

### **Context group English translation:**

Now we will read you the instructions of the experiment. From now on until you are told otherwise please don't interact with your peers in any form. You will be handed a blank paper and a pen. After receiving these, please write down your participant ID on your paper. Then you will be shown a picture. You can look at this picture for 30 seconds. Then you will hear a short pre recorded text which

you will have to memorise. After hearing the text you will be asked to count backwards from 60 aloud. Then you will have to write down all the information you remember from the text that you heard. For this you will be given 7 minutes. At the end of the 7 minutes you will have to put your pen down and let the researcher collect your paper.

**Context group Hungarian:**

*Most felolvasom a kísérlet utasításait. Mostantól kezdve, amíg másképp nem utasítanak, kérek, semmilyen formában ne lépj kapcsolatba társaiddal. Kapni fogsz egy üres papírt és egy tollat. Miután megkaptad ezeket, kérek, írd le a papírra a résztvevő azonosítódát. Ezután mutani fogunk neked egy képet, amit 30 másodpercig nézhetsz. Majd egy rövid, előre felvett szöveget fogsz hallani, amelyet memorizálnod kell. Miután meghallgattad a szöveget, arra fogunk kérni, hogy számolj vissza 60-tól hangosan. Majd írd le minden információt, amire emlékszel a hallott szövegből. Erre 7 percet kapsz. A 7 perc leteltével, kérek tedd le a tollat, és hagyd, hogy a kutató összegyűjtse a papírod.*

## Informed Consent Form

### IB Psychology IA – Experimental Study

I, \_\_\_\_\_ give my consent to participate in the IB Psychology Experimental Study about „The effect of context on the recall of text passages” run by second year IB students ( \_\_\_\_\_ ) on 2021.09.02.

- I have been informed about the nature of this experiment.
- I understand that my participation is voluntary.
- I may withdraw from the study at any time and request that my data not be used in the experimental results.
- I have the right to a debriefing about the general results of the study and I may obtain my individual results upon request.
- I give my consent knowing that all aspects of my participation will remain confidential and that I will not be subjected to any harm or deception.

I understand that the experiment has potential benefits. The aim of all IB Psychology experiments is to improve cognitive processing skills in areas such as memory, perception, problem-solving, and attention.

\_\_\_\_\_, 2021.09.02.

---

Signature

## Appendix 6 – Standardized text passage used in the experiment

### **Original text passage:**

“If the balloons popped, the sound wouldn’t be able to carry since everything would be too far away from the correct door. A closed window would also prevent the sound from carrying, since most buildings tend to be well insulated. Since the whole operation depends on a steady flow of electricity, a break in the middle of the wire would also cause problems. Of course, the fellow could shout, but the human voice is not loud enough to carry that far. An additional problem is that a string could break on the instrument. Then there could be no accompaniment to the message. It is clear that the best situation would involve less distance. Then there would be fewer potential problems. With face to face contact, the least number of things could go wrong”. (Bransford and Johnson, 1972, p 719)

### **Text passage translated to Hungarian:**

*Ha a lufik kipukkannának, a hang nem tudna terjedni, mivel minden túl messze lenne a megfelelő emeletről. Ha be lenne csukva az ablak, az is meggátolhatná a hang terjedését, mivel a legtöbb épületnek általában jó a szigetelése. Mivel az egész művelet azon áll vagy bukik, hogy biztosítható-e az elektromosság egyenletes áramlása, egy szakadás a vezeték közepén is gondokat okozna. Persze, a fickó kiálthatna is de az emberi hang nem elég hangos ahhoz, hogy elérjen olyan messzire. További probléma, hogy a húr elszakadhat a hangszeren. Ebben az esetben nem lenne kíséret az üzenet mellé. Egyértelmű, hogy az lenne a legjobb eset, ahol kisebb a távolság. Ebben az esetben kevesebb lenne a potenciális probléma. Szemtől szembeni kontaktussal kerülhető el a legtöbb hiba.*

## Appendix 7 – Idea units in Hungarian

1. *Ha a lufik kipukkannának, a hang nem tudna terjedni*
2. *mivel minden túl messze lenne a megfelelő emelettől*
3. *Ha be lenne csukva az ablak, az is meggátolhatná a hang terjedését,*
4. *mivel a legtöbb épületnek általában jó a szigetelése*
5. *Mivel az egész művelet azon áll vagy bukik, hogy biztosítható-e az elektromosság egyenletes áramlása*
6. *egy szakadás a vezeték közepén is gondokat okozna.*
7. *Persze, a fickó kiálthatna is*
8. *de az emberi hang nem elég hangos ahhoz, hogy elérjen olyan messzire.*
9. *További probléma, hogy a húr elszakadhat a hangszeren.*
10. *Ebben az esetben nem lenne kíséret az üzenet mellé.*
11. *Egyértelmű, hogy az lenne a legjobb eset, ahol kisebb a távolság.*
12. *Ebben az esetben kevesebb lenne a potenciális probléma.*
13. *Szemtől szembeni kontaktussal kerülhető el a legtöbb hiba.*

Appendix 8 – Standardized context picture

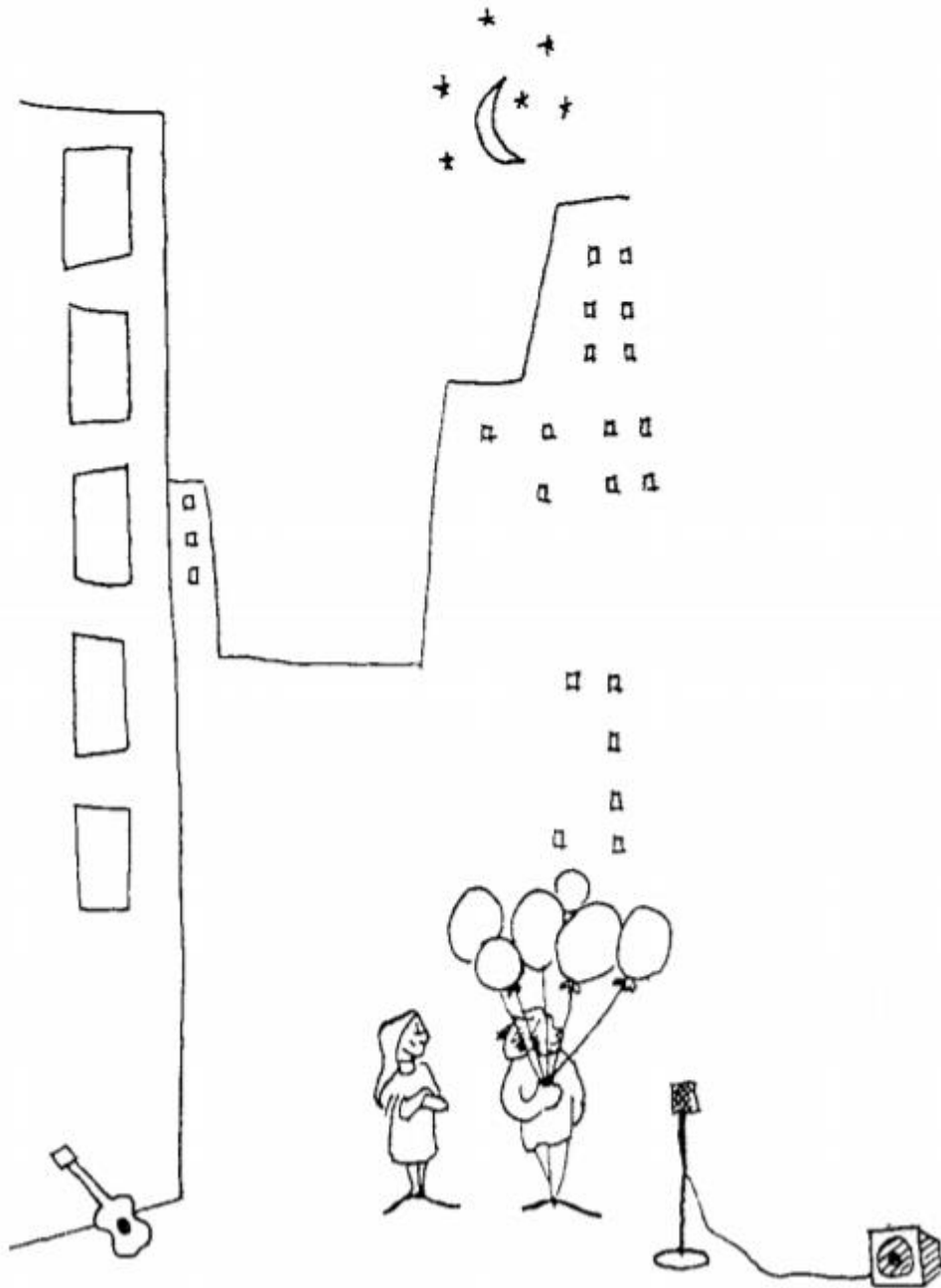


Figure 1 - Context picture (Source: Bransford and Johnson, 1972)

## Appendix 9 – Calculations for descriptive statistics

### Descriptive Statistics Calculator

---

Descriptive Statistics Calculator

Enter Data Set

2, 2, 3, 3, 4, 4, 5, 5, 5, 7, 7, 7, 8, 9

Sample     Population

Answer:  
Descriptive Statistics:

Minimum	min = 2
Maximum	max = 9
Range	R = 7
Size	n = 14
Sum	sum = 71
Mean	$\mu = 5.07142857$
Median	$\tilde{x} = 5$
Mode	mode = 5, 7
Standard Deviation	$\sigma = 2.15354478$
Variance	$\sigma^2 = 4.6377551$
Mid Range	MR = 5.5
Quartiles	Quartiles: Q <sub>1</sub> → 3 Q <sub>2</sub> → 5 Q <sub>3</sub> → 7
Interquartile Range	IQR = 4
Outliers	none
Sum of Squares	SS = 64.9285714
Mean Absolute Deviation	MAD = 1.80612245

Root Mean Square	RMS = 5.50973165
Std Error of Mean	$SE_{\mu} = 0.575559051$
Skewness	$\gamma_1 = 0.207983571$
Kurtosis	$\beta_2 = 1.89524992$
Kurtosis Excess <small>(Kurtosis in Excel and Sheets)</small>	$\alpha_4 = -1.10475008$
Coefficient of Variation	CV = 0.424642632
Relative Standard Deviation	RSD = 42.4642632%

**Frequency Table**

Value	Frequency	Frequency %
2	2	14.29
3	2	14.29
4	2	14.29
5	3	21.43
7	3	21.43
8	1	7.14
9	1	7.14

Figure 2 - Descriptive statistics calculation for the Context group  
 (using: <https://www.calculatorsoup.com/calculators/statistics/descriptivestatics.php>)



## Descriptive Statistics Calculator

Descriptive Statistics Calculator

Enter Data Set

1, 2, 2, 2, 3, 3, 3, 3, 3, 4, 4, 5, 5, 5, 6, 8

Sample     Population

**Answer:**  
**Descriptive Statistics:**

Minimum	min = 1
Maximum	max = 8
Range	R = 7
Size	n = 16
Sum	sum = 59
Mean	$\mu = 3.6875$
Median	$\tilde{x} = 3$
Mode	mode = 3
Standard Deviation	$\sigma = 1.72187216$
Variance	$\sigma^2 = 2.96484375$
Mid Range	MR = 4.5
Quartiles	Quartiles: Q <sub>1</sub> --> 2.5 Q <sub>2</sub> --> 3 Q <sub>3</sub> --> 5
Interquartile Range	IQR = 2.5
Outliers	none
Sum of Squares	SS = 47.4375
Mean Absolute Deviation	MAD = 1.3984375

Root Mean Square	RMS = 4.06970515
Std Error of Mean	$SE_{\mu} = 0.430468041$
Skewness	$\gamma_1 = 0.783054739$
Kurtosis	$\beta_2 = 3.27778385$
Kurtosis Excess <i>(Kurtosis in Excel and Sheets)</i>	$\alpha_4 = 0.277783853$
Coefficient of Variation	CV = 0.466948384
Relative Standard Deviation	RSD = 46.6948384%

**Frequency Table**

Value	Frequency	Frequency %
1	1	6.25
2	3	18.75
3	5	31.25
4	2	12.50
5	3	18.75
6	1	6.25
8	1	6.25

Figure 3 - Descriptive statistics calculations for the No context group  
(using: <https://www.calculatorsoup.com/calculators/statistics/descriptivestatics.php>)

## Appendix 10 – Calculations for inferential statistics

### T-Test Calculator for 2 Independent Means

Success!

#### Explanation of results

The output of this calculator is pretty straightforward. The values of  $t$  and  $p$  appear at the bottom of the page. If the text is blue, your result is significant; if it's not, it's not. The only thing that might catch you out is the way that we've rounded the data. The data you see in front of you, apart from the  $t$  and  $p$  values at the page bottom, has been rounded to 2 significant figures. However, we did not round when actually calculating the values of  $t$  and  $p$ . This means if you try to calculate these values on the basis of the summary data provided here, you're likely going to end up with a different, less accurate, result. This is especially the case if you're dealing with numbers that are fractions of 1.

Treatment 1 (X)	Diff(X - M)	Sq. Diff(X - M) <sup>2</sup>
2	-3.07	9.43
2	-3.07	9.43
3	-2.07	4.29
3	-2.07	4.29
4	-1.07	1.15
4	-1.07	1.15
5	-0.07	0.01
5	-0.07	0.01
5	-0.07	0.01
7	1.93	3.72
7	1.93	3.72
7	1.93	3.72
8	2.93	8.58
9	3.93	15.43
M: 5.07		SS: 64.93

Treatment 2 (X)	Diff(X - M)	Sq. Diff(X - M) <sup>2</sup>
1	-2.69	7.22
2	-1.69	2.85
2	-1.69	2.85
2	-1.69	2.85
3	-0.69	0.47
3	-0.69	0.47
3	-0.69	0.47
3	-0.69	0.47
4	0.31	0.10
4	0.31	0.10
5	1.31	1.72
5	1.31	1.72
5	1.31	1.72
6	2.31	5.35
8	4.31	18.60
M: 3.69		SS: 47.44

Significance Level:

- .01  
 .05  
 .10

One-tailed or two-tailed hypothesis?:

- One-tailed  
 Two-tailed

#### Difference Scores Calculations

##### Treatment 1

$$\begin{aligned}
 N_1 &: 14 \\
 df_1 &= N - 1 = 14 - 1 = 13 \\
 M_1 &: 5.07 \\
 SS_1 &: 64.93 \\
 s^2_1 &= SS_1 / (N - 1) = 64.93 / (14 - 1) = 4.99
 \end{aligned}$$

##### Treatment 2

$$\begin{aligned}
 df_2 &= N - 1 = 16 - 1 = 15 \\
 M_2 &: 3.69 \\
 SS_2 &: 47.44 \\
 s^2_2 &= SS_2 / (N - 1) = 47.44 / (16 - 1) = 3.16
 \end{aligned}$$

#### T-value Calculation

$$\begin{aligned}
 s^2_p &= ((df_1 / (df_1 + df_2)) * s^2_1) + ((df_2 / (df_1 + df_2)) * s^2_2) \\
 &= ((13 / 28) * 4.99) + ((15 / 28) * 3.16) = 4.01
 \end{aligned}$$

$$s^2_{M_1} = s^2_p / N_1 = 4.01 / 14 = 0.29$$

$$s^2_{M_2} = s^2_p / N_2 = 4.01 / 16 = 0.25$$

$$t = (M_1 - M_2) / \sqrt{(s^2_{M_1} + s^2_{M_2})} = 1.38 / \sqrt{0.54} = 1.89$$

The  $t$ -value is 1.88772. The  $p$ -value is .034734. The result is significant at  $p < .05$ .

Note: If you wish to calculate the effect size, this calculator will do the job.

Figure 4 - Inferential statistical calculations

Chi-Square Test Calculator. (2021, September 13). Retrieved from <https://www.socscistatistics.com/tests/chisquare2/default2.aspx>.